

TOOELE CHEMICAL AGENT DISPOSAL FACILITY (TOCDF)



MUSTARD AGENT TRIAL BURN PLAN FOR THE LIQUID INCINERATORS

Revision 1

April 6, 2006

EXECUTIVE SUMMARY

The Tooele Chemical Agent Disposal Facility (TOCDF) was designed and built for the United States (U.S.) Army to destroy the chemical agent munitions stockpile at the Deseret Chemical Depot (DCD), located 20 miles south of Tooele, Utah. EG&G Defense Materials, Inc., (EG&G) operates the TOCDF under contract to the Army through the Chemical Materials Agency (CMA).

The U.S. Environmental Protection Agency (EPA) identification number for the TOCDF is UT5210090002. The facility operates under a Resource Conservation and Recovery Act (RCRA) Part B permit, issued pursuant to the delegation of the State of Utah, Department of Environmental Quality (DEQ), Division of Solid and Hazardous Waste (DSHW), under the Utah Administrative Code, Section 315. In addition, the TOCDF also operates under a Title V air permit administered by the State of Utah DEQ, Division of Air Quality (DAQ). Under the requirements of these permits, the incinerator system must demonstrate the ability to effectively treat any hazardous wastes such that human health and the environment are protected.

This plan addresses the testing to be conducted in the Liquid Incinerators (LICs) as a combined: 1) Mustard Agent Trial Burn (ATB) to fulfill the trial burn requirements of the RCRA permit for mustard agent processing; and 2) Comprehensive Performance Test to fulfill the air permit requirements of 40 CFR 63, Subpart EEE [i.e., Hazardous Waste Combustors (HWC) Maximum Achievable Control Technology (MACT) regulations]. The test will generate the data required to update the DCD Human Health Risk Assessment (HHRA). In addition, this test will also fulfill the Title V air permit condition to test the particulate matter, carbon monoxide, and sulfur dioxide emissions every five years. Test results will demonstrate compliance with the performance standards specified in the RCRA Permit and the HWC Final Replacement standards that were published in the Federal Register, October 12, 2005.

The LIC Mustard ATB will be conducted at one set of operating conditions, which will demonstrate the minimum temperatures in the Primary and Secondary Combustion Chambers (PCC and SCC, respectively). The mustard feed will be spiked with solutions containing selected metals to allow the demonstration of maximum feed rates of mustard and metals during the same test. The metals will be spiked into the agent feed line, which precedes the agent feed nozzle. The exhaust gas samples collected will be for mustard, particulate matter, hydrogen chloride, chlorine, hydrogen fluoride, metals, volatile organic compounds, semi-volatile organic compounds, polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans, total organic compounds, total hydrocarbons, nitrogen oxides, and sulfur dioxide. The results of this ATB will establish an operating envelope that will be applicable to both LICs.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACAMS	Automatic Continuous Air Monitoring System
ACS	Agent Collection System
ADAFD	ACAMS Dilution Air Flow Controller
AQS	Agent Quantification System
ASTM	American Society for Testing and Materials
ATB	Agent Trial Burn
AWFCO	Automatic Waste Feed Cutoff
Brine	Wet Scrubber Recirculation Brine
BRA	Brine Reduction Area
CAL	Chemical Assessment Laboratory
CEMS	Continuous Emission Monitoring System
CHB	Container Handling Building
CFR	Code of Federal Regulations
CMA	Chemical Materials Agency
CON	Control Room
CPT	Comprehensive Performance Test
DAAMS	Depot Area Air Monitoring System
DAQ	Department of Environmental Quality (State of Utah), Division of Air Quality
DCD	Deseret Chemical Depot
DDAFD	DAAMS Dilution Air Flow Controller
Decon	Spent Decontamination Solution
DEQ	State of Utah Department of Environmental Quality
DFS	Deactivation Furnace System
DI	Deionized (as in deionized water)
DRE	Destruction and Removal Efficiency
DSHW	State of Utah Department of Environmental Quality, Division of Solid and Hazardous Waste
EG&G	EG&G Defense Materials, Inc.
EPA	U.S. Environmental Protection Agency
ETL	Extreme Temperature Limit
GC	Gas Chromatograph
GC/FID	Gas Chromatograph/Flame Ionization Detector
GC/FPD	Gas Chromatograph/Flame Photometric Detector
GC/MS	Gas Chromatograph/Mass Spectrometer

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

H	Levinstein Mustard
HD	Distilled Mustard
HT	Mixture <i>bis</i> (2-chloroethyl)sulfide and <i>bis</i> [2-(2-chloroethylthio)ethyl] ether
HAP	Hazardous Air Pollutant
HHRA	Human Health Risk Assessment
HRGC/HRMS	High Resolution Gas Chromatograph/High Resolution Mass Spectrometer
HWC	Hazardous Waste Combustor
HRA	Hourly Rolling Average
IC	Ion Chromatography
ICP	Inductively Coupled Plasma
ICP/MS	Inductively Coupled Plasma/Mass Spectrometry
ID	Induced Draft
IDLH	Immediately Dangerous to Life or Health (0.7 mg/m ³)
JACADS	Johnston Atoll Chemical Agent Disposal System
LCO	Limiting Conditions of Operation
LIC	Liquid Incinerator
LOP	Laboratory Operating Procedure
LOQ	Limit of Quantitation
MACT	Maximum Achievable Control Technology
MDB	Munitions Demilitarization Building
MEB	Mass and Energy Balances
MPF	Metal Parts Furnace
MRE	Metals Removal Efficiency
NDIR	Non-Dispersive Infrared
NOC	Notice of Compliance
NVTOC	Non-Volatile Total Organic Compounds
ONC	On-Site Container
PAS	Pollution Abatement System
PCC	Primary Combustion Chamber
PDARS	Process Data Acquisition and Recording System
PICs	Products of Incomplete Combustion
P&ID	Piping and Instrument Diagram
PLC	Programmable Logic Controller
PM	Particulate Matter
POHC	Principal Organic Hazardous Constituent
PQL	Practical Quantitation Limit
PST	Performance Specification Test

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QP	Quality Plant Sample
R315	Utah Administrative Code Section 315
RCRA	Resource Conservation and Recovery Act
SCC	Secondary Combustion Chamber
SDS	Spent Decontamination System
SEL	Source Emission Limit
SMVOC	Sampling Method for Volatile Organic Compounds
SRS	Slag Removal System
STEL	Short Term Exposure Limit
SVOC	Semi-Volatile Organic Compound
SVTOC	Semi-Volatile Total Organic Compounds
SW-846	Test Methods for Evaluating Solid Waste, 3rd Edition including Update III, USEPA, SW-846, December 1996.
TCLP	Toxicity Characteristic Leaching Procedure
TEF	Toxic Equivalency Factor
TEQ	Toxic Equivalent Concentration
THC	Total Hydrocarbons
TOC	Total Organic Compounds
TOCDF	Tooele Chemical Agent Disposal Facility
TOX	Toxic Cubicle
TSCA	Toxic Substances Control Act
UPS	Uninterruptible Power Supply
U.S.	United States
VOC	Volatile Organic Compound
VTOC	Volatile Total Organic Compounds

LIST OF UNITS AND MEASUREMENTS

acfm	actual cubic feet per minute
Btu/hr	British thermal units per hour
Btu/lb	British thermal units per pound
cP	centiPoise
cfm	cubic feet per minute
°C	degree centigrade
°F	degree Fahrenheit
dscf	dry standard cubic foot
dscfm	dry standard cubic feet per minute
dscm	dry standard cubic meter
ft	foot
ft ³	cubic foot
g	gram
g/sec	grams per second
gal	gallon
gpm	gallons per minute
gr/dscf	grains per dry standard cubic foot (1 atmosphere, 68 °F)
hp	horsepower
inHg	inches of mercury
inWC	inches of water column
L	liter
L/m	liters per minute
lb/ft ³	pounds per cubic foot
μg	microgram
m ³	cubic meter
mg	milligram
mL	milliliter
<u>N</u>	Normal
ng	nanogram
ppb	parts per billion
ppm	parts per million
ppmdv	parts per million on a dry volume basis
lb/hr	pounds per hour
psi	pounds per square inch
psig	pounds per square inch gauge
scfm	standard cubic feet per minute
ΔP	pitot velocity pressure
Wt%	weight percent

LIST OF CHEMICAL SYMBOLS AND FORMULAS

Al	aluminum
Ag	silver
As	arsenic
B	boron
Ba	barium
BFB	4-Bromofluorobenzene
Be	beryllium
Cd	cadmium
Cl ⁻	chloride
Cl ₂	chlorine
CO ₂	carbon dioxide
CO	carbon monoxide
Co	cobalt
Cr	chromium
Cu	copper
HNO ₃	nitric acid
Hg	mercury
HCl	hydrogen chloride
H ₂ O ₂	hydrogen Peroxide
KMnO ₄	potassium permanganate
Mn	manganese
Mustard Agent	<i>bis</i> (2-chloroethyl) sulfide
NaOH	sodium hydroxide
NaOCl	sodium hypochlorite
H ₂ SO ₄	sulfuric acid
Ni	nickel
NO _x	nitrogen oxides
O ₂	oxygen
P	phosphorus
Pb	lead
PCBs	polychlorinated biphenyls
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofurans
Q	1,2- <i>bis</i> (2-chloroethylthio)ethane

LIST OF CHEMICAL SYMBOLS AND FORMULAS (continued)

Sb	antimony
Se	selenium
SO ₂	sulfur dioxide
Sn	tin
T	<i>bis</i> [2-(2-chloroethylthio)ethyl] ether
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
Tl	thallium
V	vanadium
Zn	zinc

LIST OF IDENTIFICATION CODES FOR LIQUID INCINERATOR 1 INSTRUMENTS MONITORING REGULATED OPERATING PARAMETERS

13-TIT-610 ^a	Primary Chamber Exhaust Gas Temperature
13-FIT-127 ^a	Primary Chamber Agent Feed Rate, Hourly Rolling Average
13-PIT-128 ^b	Primary Chamber Atomizing Air Pressure
13-TIT-129 ^a	Secondary Chamber Exhaust Gas Temperature
13-FIT-102 ^a	Secondary Chamber SDS Feed Rate, Hourly Rolling Average
24-PDIT-090 ^a	Venturi Scrubber Differential Pressure, Hourly Rolling Average
24-FIT-088 ^a	Venturi Scrubber Brine Feed, Hourly Rolling Average
24-PIT-100 ^b	Quench Brine Delivery Pressure
24-FIT-112 ^a	Scrubber Tower Clean Liquor Feed, Hourly Rolling Average
24-PIT-129 ^b	Scrubber Tower Clean Liquor Delivery Pressure, Hourly Rolling Average
24-AIT-091 ^a	Brine pH, Hourly Rolling Average
24-DIT-083 ^a	Brine Density, 12-Hour Rolling Average
24-AIT-116 ^c	Clean Liquor pH, Hourly Rolling Average
13-AIT-083 ^a	Exhaust Gas CO Concentration, Hourly Rolling Average, corrected to 7% O ₂
24-AIT-078 ^a	Exhaust Gas CO Concentration, Hourly Rolling Average, corrected to 7% O ₂
24-AIT-210 ^b	Exhaust Gas O ₂ Concentration
13-AIT-229 ^b	Exhaust Gas O ₂ Concentration
24-DIT-117 ^c	Clean Liquor Density, 12-Hour Rolling Average
24-PDIT-108 ^c	Scrubber Tower Packed Bed Differential Pressure, Hourly Rolling Average
24-FIT-9431 ^a	Exhaust Gas Flow Rate, Hourly Rolling Average
24-PIT-9431 ^a	V-Cone Pressure
24-TIT-9431 ^a	V-Cone Temperature

^a Required by TOCDF RCRA Permit and HWC MACT Regulations

^b Required by TOCDF RCRA Permit

^c Required by HWC MACT Regulations

LIST OF IDENTIFICATION CODES FOR LIQUID INCINERATOR 2 INSTRUMENTS MONITORING REGULATED OPERATING PARAMETERS

13-TIT-710 ^a	Primary Chamber Exhaust Gas Temperature
13-FIT-731 ^a	Primary Chamber Agent Feed Rate, Hourly Rolling Average
13-PIT-736 ^b	Primary Chamber Atomizing Air Pressure
13-TIT-782 ^a	Secondary Chamber Exhaust Gas Temperature
13-FIT-763 ^a	Secondary Chamber SDS Feed Rate, Hourly Rolling Average
24-PDIT-814 ^a	Venturi Scrubber Differential Pressure, Hourly Rolling Average
24-FIT-828 ^a	Venturi Scrubber Brine Feed, Hourly Rolling Average
24-PIT-838 ^b	Quench Brine Delivery Pressure
24-FIT-825 ^a	Scrubber Tower Clean Liquor Feed, Hourly Rolling Average
24-PIT-839 ^b	Scrubber Tower Clean Liquor Delivery Pressure, Hourly Rolling Average
24-AIC-831 ^a	Brine pH, Hourly Rolling Average
24-DIT-835 ^a	Brine Density, 12-Hour Rolling Average
13-AIT-778 ^a	Exhaust Gas CO Concentration, 60-minute rolling average, corrected to 7% O ₂
24-AIT-716 ^a	Exhaust Gas CO Concentration, Hourly Rolling Average, corrected to 7% O ₂
24-AIT-717 ^c	Exhaust Gas O ₂ Concentration
13-AIT-798 ^c	Exhaust Gas O ₂ Concentration
24-AIC-832 ^c	Clean Liquor pH, Hourly Rolling Average
24-DIT-826 ^c	Clean Liquor Density, 12-Hour Rolling Average
24-PDIT-822 ^c	Scrubber Tower Packed Bed Differential Pressure, Hourly Rolling Average
24-FIT-9902 ^a	Exhaust Gas Flow Rate, Hourly Rolling Average
24-PIT-9902 ^a	V-Cone Pressure
24-TIT-9902 ^a	V-Cone Temperature

^a Required by TOCDF RCRA Permit and HWC MACT Regulations

^b Required by TOCDF RCRA Permit

^c Required by HWC MACT Regulations

1.0 INTRODUCTION

The Tooele Chemical Agent Disposal Facility (TOCDF) is a hazardous waste disposal facility that was designed and built for the United States (U.S.) Army for the destruction of the chemical agent munitions stockpile at the Deseret Chemical Depot (DCD), located 20 miles south of Tooele, Utah. The TOCDF is designed to dispose of chemical Agents GB, VX, and mustard (H-series), drained munitions, contaminated refuse, bulk containers, liquid wastes, explosives, and propellant components. EG&G Defense Materials, Inc., (EG&G) operates the TOCDF under contract to the Army through the Chemical Materials Agency (CMA).

The U.S. Environmental Protection Agency (EPA) identification number for the TOCDF is UT5210090002. The facility operates under a Resource Conservation and Recovery Act (RCRA) Part B permit, issued pursuant to the delegation of the State of Utah, Department of Environmental Quality (DEQ), Division of Solid & Hazardous Waste (DSHW) under the Utah Administrative Code, Section 315 (R315). The TOCDF also operates under a Title V air permit administered by the State of Utah, DEQ, Division of Air Quality (DAQ). These permits require that the incinerators demonstrate an ability to effectively treat any hazardous waste such that human health and the environment are protected by conducting trial burns to meet the RCRA requirements and a Comprehensive Performance Test (CPT) to meet the Title V and Hazardous Waste Combustors (HWC) Maximum Achievable Control Technology (MACT) requirements.

The TOCDF operates four incinerator systems to dispose of the chemical agents stored at DCD. These incinerators include the two liquid incinerators (LIC1 and LIC2), the Metal Parts Furnace (MPF), and the Deactivation Furnace System (DFS). Agent Trial Burns (ATBs) will be conducted in the MPF and LICs as the systems begin processing mustard agent. This plan will describe how TOCDF intends to use mustard from ton containers to conduct a combined ATB and CPT in one of the LICs, which will be referred to as the LIC Mustard ATB. The MPF ATB will be addressed in a separate ATB Plan. The DFS will operate under the permit conditions established by the VX ATB since measurable amounts of mustard will not be fed directly into the DFS during the TOCDF Mustard Campaign.

This plan also serves as the notification that TOCDF plans to conduct a Mustard CPT for the LICs. The testing will be conducted in one LIC, but it will provide compliance for both LICs since the two systems are identical and operated under the same conditions. The feed rates, flows and temperatures demonstrated during the LIC Mustard ATB will be used to set limits and operating parameters for both LICs when the testing is completed.

This ATB plan will describe how TOCDF will:

- Demonstrate that mustard agent can be destroyed in accordance with the RCRA requirements outlined in Title 40, Code of Federal Regulations, Part 264, Paragraph 343 (40 CFR 264.343) and the Utah Administrative Code, R315–8–15.
- Use sampling and analysis methods from Test Methods for Evaluating Solid Waste (SW-846) (1), 40 CFR 60, Appendix A (2), and Tooele Laboratory Operating Procedures (TE-LOP) to measure the emissions from the LICs to meet the required standards.

A separate Continuous Emissions Monitoring System (CEMS) performance evaluation is conducted annually for each LIC's CEMS as directed by Attachment 20 to the TOCDF Permit (3). The LIC Mustard ATB Plan was developed using the EPA guidance in the "Hazardous Waste Combustion Unit Permitting Manual" (4). In addition, this plan is submitted as a RCRA permit modification for the treatment of mustard agent in the two LICs. Regulatory reference citations are given, as appropriate, throughout this trial burn plan.

1.1 MUSTARD AGENT TRIAL BURN PLAN ORGANIZATION

This plan is a stand-alone document to allow a separate review from that of the modifications to the TOCDF permits. The plan describes the operating conditions for the testing and the samples to be collected as part of the LIC Mustard ATB. The Quality Assurance Project Plan (QAPP) (Appendix A) describes the sampling and analyses to be conducted. Appendix B contains the LIC Shakedown Plan for the period prior to the LIC Mustard ATB. The Mass and Energy Balances (MEBs) are found in Appendix C. The Automatic Waste Feed Cutoffs (AWFCOs) are summarized in separate tables for LIC1 and LIC2 in Appendix D. Appendix E is a summary of the mustard agent characterization data. Appendix F discusses the Alternate Monitoring Requests to be used with the Mustard Campaign. Appendix G provides an outline of the ATB Report. Referenced Drawings for LIC1 are found in Appendix H, and Appendix I contains the referenced drawings for LIC2.

This introduction provides an overview of the plan, including:

- Process descriptions;
- Waste feed descriptions;
- Trial burn objectives;
- Trial burn approach;
- Trial burn program;
- Trial burn protocol; and
- Expected final permit conditions resulting from the trial burn.

1.2 FACILITY INFORMATION

The TOCDF is located in EPA Region 8. The TOCDF EPA Identification Number is UT5210090002, which is also the DSHW permit number. The DCD Title V Operating Permit Number is 4500071001.

The LIC Mustard ATB points of contact are:

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1.3 WASTE TREATMENT SYSTEM PROCESS AND FEED DESCRIPTIONS

The various types of munitions and bulk items processed at TOCDF require the operation of different combinations of incinerators. Therefore, the TOCDF is designed to operate as an integrated plant with all incinerators capable of operating concurrently. The mustard agent for the LIC Mustard ATB will be drained from ton containers. This means that, in addition to the LIC, the MPF will be operated to process the drained ton containers. While LIC Mustard ATB runs are being conducted, the MPF may be processing.

This plan covers only the LICs and their associated pollution abatement systems (PAS). The descriptions of the waste handling and storage systems contained herein are provided as supplemental information to facilitate an understanding of their configuration relative to the balance of the waste treatment system. An overview of the facility is provided in Appendix H, the facility site plan, Drawing TE-16-C-2.

Each LIC includes a Primary Combustion Chamber (PCC) for agent incineration followed by a

Secondary Combustion Chamber (SCC). The SCC primarily incinerates spent decontamination solution (Decon), but also provides additional residence time for PCC exhaust gases. Exhaust gases from the SCC are then routed to the PAS for removal of air pollutants. Brief descriptions of the major discrete components follow, and a detailed system description is provided in Section 2 of this plan.

1.3.1 Waste Handling and Storage

The demilitarization process begins with the transport of chemical munitions from their storage site at DCD Area 10 to the TOCDF for processing. Munitions and ton containers are moved from Area 10 to the TOCDF Container Handling Building (CHB) in On-Site Containers (ONCs). The ONCs are temporarily stored in the CHB until they are moved into the Munitions Demilitarization Building (MDB) where the munitions and bulk storage containers are removed from the ONCs and then processed. The mustard agent drained from the munitions and bulk containers is pumped to the Agent Collection System (ACS) Tanks. Any residual mustard agent in the munitions and storage containers is destroyed in the MPF during treatment of those items. Materials treated in the MPF will be handled as directed in the Waste Analysis Plan, Attachment 2 of the TOCDF RCRA Permit.

During the demilitarization process, the facility generates Decon, which is captured in MDB sumps and pumped to one of three Spent Decontamination System (SDS) collection tanks where it is stored until processed in a LIC SCC. Each tank is sampled after it has been filled and analyzed for mustard and total organics in accordance with the TOCDF RCRA Permit, Attachment 22. If the sample meets the treatment completion criteria, the Decon is pumped through a spray nozzle into the top of the SCC.

Acid gases generated during combustion are removed from the exhaust gases by the PAS. The Wet Scrubber Recirculation Brine (Brine) removes the acid gases and neutralizes the acidic compounds. The Brine removed from the PAS is stored in tanks until it is shipped off-site for disposal.

1.3.2 Combustion Process

The LICs were custom designed by T-Thermal, Inc., and hence have no model designation. Each PCC is refractory lined and about 4 feet (ft) 4 inches in diameter by 11 ft 5 inches in height. Both LIC PCCs are rated for a maximum of 14 million British thermal units/hour (Btu/hr) allowing a maximum mustard agent feed rate of 1,275 pounds per hour (lb/hr). Mustard agent and natural gas are fed with atomizing air and combustion air through the burner nozzle into the PCC. The fuel mixture burns at temperatures between 2,500 °F and 2,850 °F. The induced draft (ID) fans draw the exhaust gases from the PCC through the refractory-lined crossover duct to the SCC.

The SCC is a refractory-lined chamber that houses one high-velocity, gas-fired burner, which is mounted tangentially on the sidewall near the top of the chamber. The SCC is rated at 8 million Btu/hr and maintains the exhaust gas temperatures between 1,800 °F and 2,200 °F. Placement of the inlet duct and the burner provide turbulent mixing of the exhaust gases with the combustion gases to assist in the destruction of the organic compounds present. There is an air-atomized liquid spray nozzle mounted on the chamber roof that sprays Decon or process water into the chamber to control the temperature and destroy organic compounds present in the Decon. The SCC is 10 ft high and 5 ft 10 inches in diameter, with a slag removal pit, 7 ft 2 inches high and 2 ft in diameter, attached to the bottom. Electric heaters around the slag pit maintain the slag in a molten state. An exhaust gas minimum temperature of 1,800 °F is maintained to the PAS inlet. The SCC provides complete thermal destruction of any organic compounds that exist in the exhaust gas.

1.3.3 Pollution Abatement System

The PAS is designed to remove acid gases, particulate matter (PM), and metals from the exhaust gases prior to discharge to the atmosphere. The PAS consists of a quench tower, high-energy venturi scrubber, packed-bed scrubber, demister, and ID fan. Exhaust gases travel from the SCC to the quench tower, where they pass through a series of Brine sprays that cool the gases by evaporating water. The quench tower has an upflow design with a diameter of 6 ft and a height of 40 ft. Under normal operating conditions, a liquid-to-gas ratio of 100 gallons per minute (gpm) to about 24,600 cubic feet per minute (cfm) is maintained. The quench tower is designed for a maximum inlet temperature of 2,200 °F and a maximum outlet temperature of 225 °F. Typical gas inlet and exit temperatures are 1,950 °F and 200 °F, respectively.

Exhaust gases pass from the quench tower through the high-energy venturi scrubber, where high-pressure Brine sprays create small droplets for efficient capture of small PM. Acid gases are absorbed by the Brine and neutralized. The venturi operates in the range of 20-to-50 inches of water column (inWC) when the system is processing agent. The exit from the venturi scrubber leads to a 90° vertical-to-horizontal elbow in the ductwork. The high velocity of the exhaust gases combined with the change of direction in flow effectively removes the PM from the gases.

The scrubber tower is a Hastelloy[®] vessel, 5 ft 6 inches in diameter and 40 ft high. Effluent from the venturi scrubber enters the scrubber tower, where the liquid falls into the tower reservoir and the gas rises through the chimneys of the clean liquor tray. The clean liquor is controlled to a pH greater than (>) 7 by the addition of 18% sodium hydroxide (NaOH). Exhaust gases are scrubbed by the clean liquor, which removes PM and any remaining acidic gases. Finally, the gases pass through a mist eliminator as they exit the scrubber tower.

Then, the exhaust gases travel from the scrubber tower to the demister. The demister is a fiberglass vessel, 11 ft in diameter and 31 ft high. Gases flow through the demister candles, which remove entrained solids and liquid droplets. Solids are trapped on the candles and liquids drain to the vessel bottom, where liquids are pumped to the scrubber reservoir.

An ID fan, which is a two stage blower, maintains the LIC and associated PAS under negative pressure to prevent fugitive emissions. The PCC is maintained in the range of 4 inWC to 7 inWC vacuum relative to the LIC furnace room.

1.3.4 Wet Scrubber Recirculation Brine Description

Acid gases generated during combustion are removed from the exhaust gases by the PAS. The Brine removes the acid gases and neutralizes the acidic compounds. The scrubber tower reservoir receives all Brine drainage from the PAS. Then, when the Brine density in the reservoir reaches a specific gravity of 1.20, the Brine is then discharged to one of four waste holding tanks for storage prior to offsite disposal. When the liquid volume in the reservoir dips below the established setpoint, process water is introduced to maintain the appropriate volume. The used Brine is stored in tanks until it is shipped offsite for disposal. The Brine normally has a pH >7.0. The Brine total dissolved solids are approximately equal to (\approx) 100,000 parts per million (ppm), and the total suspended solids are \approx 800 ppm.

1.4 WASTES TO BE TREATED

The DCD stockpile originally contained munitions and bulk storage containers of Agents GB, VX, and H-series mustard. All Agent GB and Agent VX intended for TOCDF processing has been destroyed, with the exception of the secondary wastes that are contaminated with these agents. Destruction of mustard agent will be addressed under a RCRA permit modification and by this ATB plan. The mustard agent and Decon resulting from processing mustard agent munitions constitute the wastes to be treated in the LICs during the Mustard Agent Campaign.

The State of Utah has defined mustard agent as acutely hazardous and identified it as a P999 (i.e., chemical agent) waste along with any items contaminated by mustard agent. However, TOCDF does not produce or handle any liquids containing polychlorinated biphenyls (PCB) that would be regulated under Toxic Substances Control Act (TSCA), or treat any waste materials with dioxin waste codes (F020, F021, F022, F023, F026, or F027).

Two waste streams will be treated in the LICs: mustard agent and Decon. The Chemical Weapons Convention directs that mustard agent must be destroyed; i.e., the mustard agent burned in the LICs cannot be reused, is not marketable, and is not economically recoverable. The mustard agent removed from ton containers (TCs) will be burned in the LIC PCC. This technology provides the U.S. Army with an economical and safe method for complete mustard agent destruction and disposal. The mustard agents stored at DCD include Levinstein mustard (H) stored in 155-mm projectiles, distilled mustard (HD) stored in ton containers and 4.2 inch mortars, and a mixture (HT) of *bis*(2-chloroethyl)sulfide and *bis*[2-(2-chloroethylthio)ethyl] ether (T) are stored in 4.2 inch mortars. These agents will be referred to as mustard agent for this plan. During Baseline Operations, only TCs will be drained and the mustard processed in the LICs.

Table 1-1 summarizes the data collected on the composition of the liquid mustard agent from the TCs with mercury concentrations that were less than ($<$) 1 mg/kg. This data was taken from the information in Appendix E. The mustard agent used during this ATB will be from the HD TCs. The mustard agent feed rates will be based on the total flow of mustard agent (including impurities) to the LIC, while the calculation of the Destruction and Removal Efficiency (DRE) will be based on the concentration of *bis*(2-chloroethyl) sulfide in the mustard agent.

The anticipated composition of the Decon waste stream that will be processed in the SCC is shown in Table 1-2. Decon will be treated in the SCC and will vary in sodium concentration, but will always be low in organic compound concentrations. Decon will have a mustard agent concentration that is less than ($<$) 200 parts per billion (ppb) before it can be treated in the SCC.

Spiking solutions will also be fed to the LIC during the ATB and the details for spiking are discussed in Sections 5.3.3 and 5.3.4. Two metal spiking solutions will be fed to the PCC to provide a “worst-case” test for metals emissions. The Decon has the potential to contain organic compounds that are classified as Hazardous Air Pollutants (HAPs) by EPA. As a part of this test, a surrogate HAP (chlorobenzene) will be fed to the SCC and a DRE measured to demonstrate a DRE for organic compounds fed to the SCC in the Decon.

Other mustard agent demilitarization wastes include slag and Brine, which will be collected and shipped off-site for disposal at a licensed Treatment, Storage, and Disposal Facility. These wastes will carry an F999 state waste code (i.e., waste resulting from the treatment of chemical agents) in addition to the pertinent RCRA waste codes.

TABLE 1-1. LIQUID MUSTARD AGENT CHARACTERIZATION SUMMARY

Parameter	Baseline HD TC Liquid Agent *		
	Average Value	Maximum Value	Minimum Value
Organic Compounds			
<i>Bis</i> (2-Chloroethyl)sulfide (Wt%)	89.3	101	78.7
Thiodigylcol (Wt%)	< 0.03 U	< 0.03 U	< 0.02 U
1,2-Dichloroethane (Wt%)	0.606	0.993	0.197
Tetrachloroethene (Wt%)	0.050	0.073	0.013 J
1,1,2,2-Tetrachloroethane (Wt%)	< 0.052 U	< 0.059 U	0.047 J
<i>Bis</i> [2-(2-chloroethylthio)ethyl] ether (T) (Wt%)	0.169	0.355	0.041 J
1,2- <i>Bis</i> (2-chloroethylthio)ethane (Q) (Wt%)	3.24	5.66	0.448
Hexachloroethane (Wt%)	< 0.21	< 0.29 U	0.025 J
Lewisite (mg/kg)	5.24	14.5	2.82 J
1,4-Dithiane (Wt%) [TIC]	1.1	5.6	0.028
1,4-Thioxane (Wt%) [TIC]	0.26	0.97	0.083
2-Chloroethyl 4-chlorobutyl sulfide (Wt%) [TIC]	0.51	3.0	0.079
<i>Bis</i> (2-Chloropropyl)sulfide (Wt%) [TIC]	0.19	1.0	0.043
Element (mg/kg)			
Aluminum	< 37.7 U	< 55 U	12 J
Antimony	< 5.1 U	< 5.5 U	0.67 J
Arsenic	5.80	51.6	1.29 J
Barium	< 5.1 U	< 5.5 U	0.44 J
Beryllium	< 5.2 U	< 5.5 U	< 4.8 U
Boron	< 9.3 U	< 11.1 U	4.0 J
Cadmium	< 5.2 U	< 5.5 U	< 4.8 U
Chromium	4.81	29.9	1.35 J
Cobalt	< 1.0 U	< 1.1 U	0.334 J
Copper	37.9	84.8	4.48 J
Lead	< 4.7 U	< 5.5 U	0.467 J
Manganese	1.67	6.49	0.328 J
Mercury	< 0.35 U	< 0.55 U	0.0537 J
Nickel	3.40	15.7	0.363 J
Selenium	< 10 U	< 11 U	1.19 J
Silver	< 5.2 U	< 5.5 U	1.72 J
Thallium	< 5.2 U	< 5.5 U	< 4.8 U
Tin	< 10 U	< 11 U	< 9.5 U
Vanadium	< 3.1 U	< 5.5 U	1.06 J
Zinc	9.76	29.4	3.42 J

Notes:

* This data includes TCs with liquid mustard mercury concentrations < 1 mg/kg.

U indicates that none of the values exceeded the PQL.

J indicates the value was estimated because the result was between the MDL and the PQL.

TABLE 1-2. DECON CHARACTERIZATION SUMMARY ^a

Parameter	Average	Minimum	Maximum
Carbon tetrachloride (mg/L)	17.7	0.80	32.0
Chloroethane (mg/L)	1.75	0.22	2.0
Chloroform (mg/L)	341	90.0	530
Chloromethane (mg/L)	1.9	1.2	2.0
TOC (g/L)	1.31	0.598	2.37
pH	11.3	7.38	12.27
TSS (g/L)	1.38	0.165	8.22
TDS (g/L)	93.2	68.2	134
Aluminum (mg/L)	9.2	1.4	46.7
Barium (mg/L)	1.8	0.12	11.1
Cadmium (mg/L)	0.052	0.020	0.24
Chromium (mg/L)	1.9	0.99	3.0
Copper (mg/L)	1.5	0.22	8.3
Lead (mg/L)	0.88	0.100	4.70
Manganese (mg/L)	1.64	0.140	10.3
Mercury (mg/L)	0.76	0.150	2.50
Nickel (mg/L)	2.29	0.220	13.9
Silver (mg/L)	0.073	0.050	0.097
Zinc (mg/L)	3.92	0.58	22.4

Notes:

^a Data taken from the LIC Agent VX Trial Burn Report and the Johnston Island Decon Data Summary submitted in support of a permit modification.

1.5 MUSTARD AGENT TRIAL BURN OBJECTIVES

The objectives for the TOCDF LIC Mustard ATB are to:

- Demonstrate a maximum mustard feed rate while maintaining a DRE $\geq 99.9999\%$ of the designated Principal Organic Hazardous Constituent (POHC), *bis*(2-chloroethyl)sulfide.
- Demonstrate maximum surrogate HAP feed rate to the SCC while maintaining a DRE $\geq 99.99\%$ for chlorobenzene.
- Demonstrate control of carbon monoxide (CO) emissions to < 100 parts per million dry volume (ppmdv), corrected to 7 percent oxygen (@ 7% O₂), on an Hourly Rolling Average (HRA) basis.
- Demonstrate that PM emissions are:
 - < 29.7 mg/dscm @ 7 % O₂ (MACT limit); and
 - < 1.0 lb/hr @ 7% O₂ (Title V Permit Limit).
- Demonstrate that the combined halogen emissions [hydrogen fluoride (HF), hydrogen chloride (HCl) and chlorine (Cl₂) gas] are < 32 ppm (MACT) expressed as HCl equivalents, dry basis @ 7 % O₂.
- Demonstrate that the Polychlorinated Dibenzo-*p*-dioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) emissions are < 0.40 nanograms/dscm (ng/dscm) 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD) Toxic Equivalent Concentration (TEQ) @ 7 % O₂.
- Demonstrate the mercury emissions are < 130 μg/dscm @ 7% O₂ (MACT Limit).
- Demonstrate the semi-volatile metal emissions (lead and cadmium) are < 230 μg/dscm @ 7% O₂ (MACT Limit).
- Demonstrate the low-volatility metal emissions (arsenic, beryllium, and chromium) are < 92 μg/dscm @ 7% O₂ (MACT Limit).
- Determine the metal emissions rates for use in updating the DCD Human Health Risk Assessment (HHRA).
- Provide data regarding the emissions of products of incomplete combustion (PICs) for use in updating the DCD HHRA.
- Determine the emission rate of nitrogen oxides (NO_x).

- Demonstrate that the emission rate of sulfur dioxide (SO₂) is below the Title V permit limit of 9.5 lb/hr.
- Establish limitations on waste feed characteristics and process operating conditions in order to ensure compliance with performance standards and risk-based emission limits.
- Demonstrate that the Total Hydrocarbon (THC) emissions are < 10 ppm_{dv} @ 7% O₂ over an HRA (monitored continuously with a CEMS), and reported as propane.

1.6 MUSTARD AGENT TRIAL BURN APPROACH

The LIC Mustard ATB will take the universal approach outlined in the EPA Guidance (5). The universal approach establishes one set of permit conditions or limits applicable to all feed materials. This approach will treat mustard and Decon in the LICs while confining incinerator operation to a well-defined set of operating limits or operating envelope.

It is anticipated that mustard and Decon will be processed simultaneously during the Mustard Agent Campaign. Maximum waste feed rates for each stream will be demonstrated simultaneously during the LIC Mustard ATB. The incinerator operator will thus have the flexibility to deal with combinations of both wastes while controlling the overall combustion process within specific limits (including temperature, exhaust gas velocity, and thermal duty).

1.7 PROPOSED MUSTARD AGENT TRIAL BURN PROGRAM

The TOCDF LIC is operated as a steady state incinerator. The LIC Mustard ATB will be conducted at one test condition established as a worst case condition by spiking metals into the PCC and a surrogate HAP to the SCC. The LIC temperatures will be maintained within the limits listed in Appendix D. The combustion airflows in the system vary over a small range, and system pressures are maintained negative relative to the LIC furnace rooms. The differences in the metals content among the various agent lots are anticipated to be minor, as indicated by Table 1-1, the agent feed during the mustard ATB will be spiked with metals to achieve a “worst-case” test, thereby setting a fixed metals feed rate for mustard processing. Decon fed to the SCC has the potential to contain organic compounds that are classified as HAPs by EPA. As a part of this test, a surrogate HAP (chlorobenzene) will be fed to the SCC and a DRE measured. Operation of the PAS follows the furnace; hence, fluctuations in the PAS parameters will be limited. Brine pH is controlled at a pH > 7 to remove the acid gases from the exhaust gases, and Brine flows are controlled principally to maintain PAS component liquid levels and temperatures.

1.8 MUSTARD AGENT TRIAL BURN SAMPLING AND ANALYTICAL PROTOCOLS

Detailed discussions of the sampling and analysis procedures are provided in the QAPP (Appendix A). The structure of this ATB is based on the previously stated objectives in Section 1.4. The exhaust gas sampling and analytical methods to be used to quantify specific LIC Mustard ATB parameters are taken from SW-846 (1), 40 CFR 60, Appendix A (2), and TOCDF Procedures. These methods are:

- The Depot Area Air Monitoring System (DAAMS) will monitor the exhaust gas in the LIC duct between the ID fan and the common stack (TE-LOP-522 for sampling and TE-LOP-562 for analysis) to demonstrate that the mustard DRE is $\geq 99.9999\%$.
- The Automatic Continuous Air Monitoring System (ACAMS) monitoring the LIC duct will provide a stop feed if mustard is present in the duct (TE-LOP-524).
- A CO and O₂ CEMS will monitor on a continuous basis. The CO concentration will be used to demonstrate control of PICs.
- EPA Methods 1 and 2 (2) will determine traverse sampling locations and flow rates.
- EPA Method 3A (2) will determine carbon dioxide (CO₂) concentrations using a CEMS supplied by the sampling subcontractor.
- Each isokinetic sampling train will determine the moisture content of the exhaust gas.
- EPA Method 6C (2) will determine the sulfur dioxide (SO₂) emissions with a CEMS supplied by the sampling subcontractor.
- EPA Method 7E (2) will determine the NO_x emissions with a CEMS supplied by the sampling subcontractor.
- EPA Method 5/0050 (2, 1) will determine the PM emissions and halogen (HF, HCl, and Cl₂) emissions.
- EPA Method 29 (2) will determine the HHRA metals emissions.
- SW-846, Method 0031 (1), will determine Volatile Organic Compound (VOC) emissions.
- SW-846, Method 0010 (1), will determine Semi-Volatile Organic Compounds (SVOCs) emissions.
- SW-846, Method 0023A (1), will determine PCDD/PCDF emissions.

- EPA guidance (6) will determine Volatile Total Organic Compound (VTOC) emissions.
- Semi-Volatile Total Organic Compound (SVTOC) and Non-Volatile Total Organic Compound (NVTOC) emissions will be determined per EPA guidance (6).
- Method 25A (2) will determine the THC using a sampling subcontractor CEMS.

The PICs will be determined by evaluating the VOCs, SVOCs, and PCDDs/PCDFs data. The target analyte lists for these three analyses include over 200 organic compounds. Additionally, unknown peaks will be tentatively identified as described in the QAPP (Appendix A). The Total Organic Compounds (TOC) data will be used to update the DCD HHRA.

1.9 FINAL PERMIT LIMITS

Anticipated permit operating conditions resulting from this ATB are summarized in Appendix D. Process parameters are divided into Group A, B, and C parameters as directed in EPA guidance documents. (The groupings are shown in Section 9.) Group A and B parameters will be established on the basis of LIC Mustard ATB results. Group C parameters are established on the basis of regulatory guidance, process design/safety considerations, or vendor recommendations.

Group A parameters will be continuously monitored process parameters, which will be tied to AWFCOs. Group B parameters do not require continuous monitoring and will not be interlocked with the AWFCO system; however, detailed operating records will be maintained to demonstrate compliance with permitted operating conditions. Some Group C parameters will be continuously monitored and interlocked with the AWFCO system.

Group C parameters will be established independent of trial burn results. For the most part, their respective limits will be based on engineering considerations and good operating practices. For safety and system performance purposes, the quench tower exit temperature and the differential pressure between atomizing gas and waste feed will be monitored and recorded continuously and interlocked with the AWFCO system.

During the shakedown period, the AWFCO settings for Group A and interlocked Group C parameters will be those listed in Appendix D. During the trial burn, the interlocks for these Group A and C parameters will remain operational at the limits noted in Appendix D.

1.10 JUSTIFICATION FOR EXEMPTION

The TOCDF is not seeking an exemption from any of the incinerator or trial burn requirements because the regulatory requirements of 40 CFR 270.19(a) do not apply to the TOCDF.

2.0 DETAILED ENGINEERING DESCRIPTION OF THE LIQUID INCINERATORS

This ATB plan discusses the requirements of 40 CFR 270.19(b) to conduct a trial burn. This section discusses the current engineering configuration of the TOCDF LICs as required by 40 CFR 270.62(b)(2)(ii). The operating parameters will be established by the trial burn and included in the final permits. Engineering changes that might be encountered during shakedown would necessitate revisions to this ATB plan; any such changes would be coordinated with the DAQ and DSHW.

The LIC engineering drawings and specifications were prepared by Ralph M. Parsons Company and EG&G. Selected Piping and Instrument Diagrams (P&IDs) and equipment arrangements are provided in Appendices G and H. Figure 2-1 depicts a simplified process flow diagram.

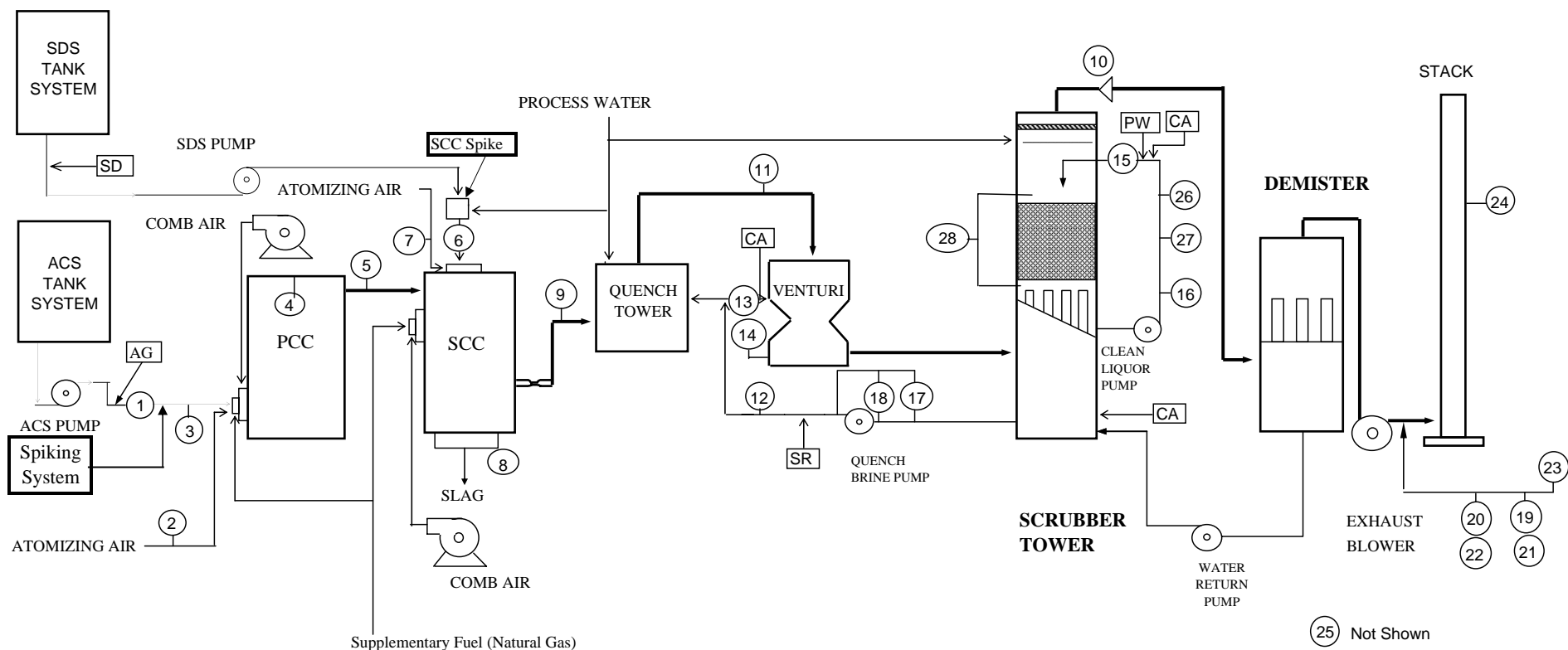
2.1 PRIMARY COMBUSTION CHAMBER

The LICs are controlled air, direct-fired, liquid-injection incinerators with a PCC and a SCC. The vessels are refractory-lined with the PCC designed to incinerate chemical agents drained from munitions and bulk containers and the SCC designed to process Decon and ensure destruction of agent. Each LIC is designed so that the waste feed is pumped at a continuous, uniform rate to the PCC. The agent feed is mixed with combustion air and is dispersed into the chamber with an air-atomizing nozzle. Supplemental fuel (natural gas) is used for temperature control within the PCC.

The LICs are custom-designed by T-Thermal, Inc., and they have been in operation since August 1996 processing Agents GB and VX. There is no model designation for the incinerator because of the unique requirements and corresponding custom design. The maximum thermal input ratings of each LIC PCC are 14 million Btu/hr. The proposed mustard waste feed rate of 1,275 lb/hr is within the designed capacity of the system.

The PCC is a refractory-lined cylinder (see Drawing 6-02-3710-D in Appendix H) approximately 4 ft 4 inches in diameter by 8 ft 2 inches in length, measured from the center line of the burner to the center line of the outlet duct. The cross-sectional area of the PCC is approximately 14.8 ft² and the total volume is approximately 121 ft³. The PCC is lined with 6 inches of SR90 refractory brick laid over 4.5 inches of K30 insulating firebrick.

Mustard and natural gas are fired through the PCC burner to maintain operating temperature. The PCC is heated to between 2,500°F and 2,850°F to oxidize agent to carbon dioxide and water. Natural gas, agent, atomizing air, and combustion air enter via the burner nozzle and are ignited in the PCC. A PCC combustion air blower supplies combustion air.



Notes:

AG = Agent Sample Location
 PW = Process Water Addition Location
 CA = NaOH Addition Locations
 SLAG = Slag Drain Location
 SR = Wet Scrubber Recirculation Brine Sample Location
 SD = Spent Decon Sample Location

IDENTIFICATION OF RCRA/MACT INSTRUMENTS

- | | |
|---|--|
| 1. Agent Feed Rate to Primary Chamber, lbs./hr | 15. Clean Liquor to Scrubber Tower Sprays, gpm |
| 2. Agent Feed Atomizing Air Pressure, psig | 16. Clean Liquor Delivery Pressure, psig |
| 3. Agent Gun Nozzle Pressure, psig | 17. Quench Brine pH |
| 4. Primary Chamber Pressure, psig | 18. Quench Brine Density, sgu |
| 5. Primary Chamber Exhaust Gas Temperature, °F | 19. Exhaust Gas CO, ppm |
| 6. Secondary Chamber Spent Decon/Process Water Feed Rate, lb/hr | 20. Exhaust Gas CO, ppm |
| 7. Secondary Chamber Spent Decon/Process Water Atomizing Air Pressure, psig | 21. Exhaust Gas O ₂ , Volume % |
| 8. Secondary Chamber Slag Gate Open | 22. Exhaust Gas O ₂ , Volume % |
| 9. Secondary Chamber Exhaust Gas Temperature, °F | 23. LIC Duct Exhaust Gas Mustard ACAMS & DAAMS |
| 10. Exhaust Gas Flow Rate, kscfm | 24. Common Stack Exhaust Gas Agent, PAS 701G, PAS 706V, PAS 707H |
| 11. Quench Tower Exhaust Gas Temperature, °F | 25. Not Shown - BRA-Tanks Filled |
| 12. Quench Brine Delivery Pressure, psig | 26. Clean Liquor pH |
| 13. Quench Brine to Venturi Scrubber, gpm | 27. Clean Liquor Density, sgu |
| 14. Venturi Scrubber Differential Pressure, inWC | 28. Scrubber Tower Differential Pressure, inWC |

FIGURE 2-1. LIQUID INCINERATOR PROCESS FLOW DIAGRAM

Atomizing air is supplied by the plant air system and is used to cool the waste feed nozzle when there is no agent feed. Drawing TE-1-D-526 located in Appendix H depicts the LIC1 atomizing airline and two bypass lines to the burner nozzle. The main (top) line is used only for agent feed. The pressure regulator is set at a minimum of 60 pounds per square inch (psi). The first bypass line is used only for cooling the burner nozzle and is set at 5 psi. The second bypass line is not used. Drawing TE-1-D-546 located in Appendix I shows this setup for LIC2.

The supplemental natural gas fuel is used to maintain temperatures during agent feed. Combustion air is added to the fuel at a fixed flow rate to maintain a minimum stoichiometric ratio of 1.2 (20% excess air). Approximately 0.4 pounds of atomizing air per pound of agent is added. Exhaust gases are discharged from the PCC through the refractory-lined crossover duct into the SCC at a temperature of between 2,500 °F and 2,850 °F.

2.2 SECONDARY COMBUSTION CHAMBER

The exhaust gases from the PCC are ducted to the SCC. Exit temperatures in the SCC are maintained between 1,800 °F and 2,200 °F by a supplemental fuel burner and water or Decon sprays. Besides treating Decon, the SCC is used to allow additional time at high temperatures to destroy organic compounds remaining in the exhaust gas from the PCC.

The SCC is a steel cylindrical shell lined with refractory material (see Drawing 6-02-3713-D in Appendix H). The SCC is 5 ft 10 inches in diameter and 10.0 ft high. The SCC is lined with 9 inches of high-temperature, acid-resistant, RUBY® insulating refractory brick laid over 4.5 inches of RUBY® Lite-Weight insulating firebrick. Mounted beneath the combustion section of the SCC is a slag pit that is designed to collect slag, thereby lengthening refractory life. Each slag pit is 7 ft 2 inches in length by 2.0 ft in diameter for a total volume of 22.6 ft³.

Exhaust gases can be heated in the SCC to between 1,800 °F and 2,200 °F by firing the supplemental fuel burner in the SCC. The SCC burner is rated for a maximum heat release of eight million Btu/hr. Air is added to the fuel to maintain a stoichiometric ratio of 1.2.

The LIC residence time of at least two seconds at a minimum temperature of 1,800 °F is measured from the PCC to the quench and the residence time ensures the complete destruction of any residual mustard. The SCC exhaust gas residence time is calculated from the volume of the PCC crossover duct, the SCC, and the SCC exhaust duct exit up to RCRA-Permit-regulated SCC exhaust gas temperature thermocouple 13-TE-129 (13-TE-782 for LIC2) (see Figure 2-1). For residence time calculations, the minimum design residence volume is calculated as 1,000 ft³ [846 ft³ up to the refractory venturi at the exit of the SCC and 154 ft³ between this venturi and the exhaust gas temperature thermocouple 13-TE-129 (13-TE-782 for LIC2)]. The temperature is maintained until the gases reach the quench tower (an additional 82 ft³, which is not used in the residence time calculation). Tables in Appendix C show the dimensions and volumes of the various segments of the combustion system and the calculated residence times.

Under normal conditions, the exhaust gas discharge from the PCC and SCC is estimated to be 21,240 and 26,489 actual cubic feet per minute (acfm), respectively, at 2,700 °F and 2,050 °F. Based on these flow rates, the total residence time, including the PCC, the crossover duct between the PCC and SCC, the SCC, and the duct up to the regulated temperature measurement location in the duct, is approximately 2.38 seconds (see the MEBs in Appendix C). The exhaust gas velocity in the SCC, assuming a gas flow rate of 26,498 acfm, is 16.5 ft/second. Tables showing the calculation of the residence times at the ATB conditions and the normal operating conditions are found in Appendix C.

Temperatures in the SCC are controlled by spraying aqueous streams into the SCC and by firing natural gas in the SCC burner. Decon or water is sprayed through an atomizing nozzle at the top of the SCC using atomizing air in the pressure range of 47 to 90 pounds per square inch gauge (psig). The atomized solution mixes with the PCC exhaust gases; the heat of the exhaust gas causes the water to evaporate and cool the exhaust gases. Temperatures of the hot gases destroy any organic compounds present in the exhaust gases. When Decon is not being processed, water is used for cooling the exhaust gases. When the Decon processing requirements are more than is required for cooling the exhaust gases, the temperature is maintained by burning natural gas in the SCC burner. The SCC design capacity for Decon injection is 2,100 lb/hr. Plant air is used to atomize the Decon or cooling water at a ratio of approximately 0.4 pound per pound of solution.

2.3 NOZZLE AND BURNER DESIGN

Nozzle and burner systems are located in both the PCC and the SCC. Each chamber is equipped with a single burner. Locations of the waste burners in the chambers are shown on Drawings 6-02-3710-D and 6-02-3713-D (Appendix H).

The PCC burner is a T-Thermal LV Vortex burner rated at 14 million Btu/hr. It will burn either natural gas or liquids with a minimum heat value of 4,500 British thermal unit per pound (Btu/lb) and a viscosity less than 10,000 centiPoise (cP). The injector is T-Thermal Model # 167-C, as revised November 6, 1995. Liquid mustard is injected into the PCC LV-14 Vortex burner where it is atomized to a fine spray using compressed air. Approximately 0.4 pounds of atomizing air per pound of agent is supplied by the plant air system. Atomizing air is also used to cool the waste feed nozzle when there is no agent feed. Drawing TE-1-D-526 (Appendix H) depicts the atomizing air line and two bypass lines to the burner nozzle for LIC1. The main (top) line is used only for agent feed. The pressure regulator is set at a minimum of 75 psi. The first bypass line is used only for cooling the burner nozzle and is set at 5 psi. The second bypass line is not used. Drawing TE-1-D-546 (Appendix I) shows the arrangement for LIC2.

Figure 2-2 shows that the agent injector is located axially in the high-intensity vortex burner. Combustion air is supplied tangentially to the burner via a dedicated forced-draft blower and passes through a series of swirl vanes that spin the air. This spinning air is forced through the burner's air nozzle, where it vigorously mixes with the atomized agent. The liquid droplets of mustard are quickly superheated, vaporized, and combusted in the swirling combustion gases. Also located axially in this burner is the natural gas injector. Combustion of natural gas heats the PCC to a minimum of 2,500 °F to clear the agent safety interlocks and permit waste feed. As mustard is fed, the natural gas flow is decreased automatically in response to the heat provided by the agent's rapid combustion. The burner design is such that mixing of the air streams (atomizing and combustion), natural gas, and liquid agent is allowed only at the burner tip. Upon shutdown of agent feed, a sequence of air and oil purging is used to ensure that residual agent is removed from the feed line and burner injector.

The PCC burner has a continuous gas pilot. The maximum turndown ratio of the burner will be 10:1. It is designed to produce a relatively non-luminous short flame and low NO_x emissions. Internal parts are fabricated of Hastelloy® C-276. The burner's refractory ring is constructed of SR90 brick. The burner is located in the bottom third of the PCC, opposite the exhaust gas exit to the crossover duct.

The SCC burner is an HV-645 High Velocity Burner rated at 8 million Btu/hr. The burner pilot remains on for 10 seconds to ignite the main burner. The burner burns natural gas and has a maximum turndown ratio of 10:1. The burner and internal parts are fabricated of carbon steel. The SCC burner is located near the top of the SCC opposite the discharge from the crossover duct. The SCC combustion air blower can provide up to 1,450 standard cubic feet per minute (scfm) of air at a differential pressure of 54 inWC for combustion and cooling air for the burner section of the SCC. The burner provides the energy necessary to heat the SCC to its operating temperature and to maintain SCC temperature during periods of high Decon processing.

The burners in the LIC are equipped with Fire-Eye flame scanners as part of the flame safety management system. These scanners continuously monitor flame conditions and are interlocked with AWFCOs to stop waste feed automatically in the event of a flameout.

2.4 DESCRIPTION OF THE AUXILIARY FUEL SYSTEMS

Natural gas is fired to heat both the PCC and the SCC to the proper operating temperatures prior to feeding mustard or Decon. It is supplied to the PCC through a line to the burner system and supplements the injected agent to maintain the desired combustion temperatures. Natural gas is supplied to the SCC through a line to the burner to provide supplemental heating during periods of high Decon feed rates to offset the cooling provided by the Decon. Both burners are equipped with independent monitors, controls, interlocks, and fail safe devices required by the National Fire Protection Association.

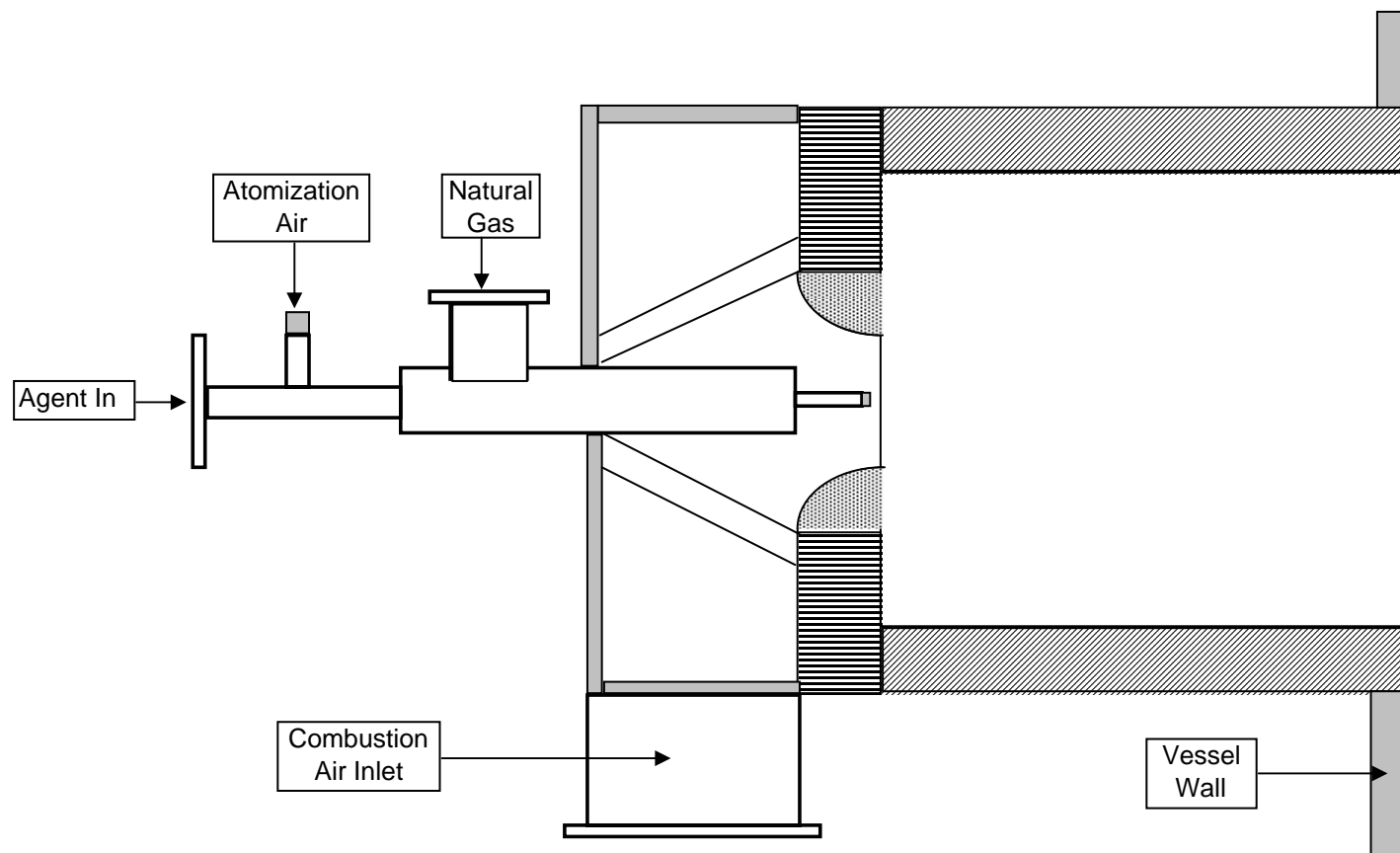


FIGURE 2-2. LIQUID INCINERATOR AGENT PRIMARY BURNER DIAGRAM

2.5 CAPACITY OF PRIME MOVER

Four blowers are used in the LICs. The exhaust gas prime mover is a Robinson Industries Inc., Model 5800, two-stage centrifugal fan that operates as an ID fan to draw the exhaust gases through the incinerator and PAS. Under normal conditions, the ID fan operates at 11,850 acfm, drawing exhaust gas saturated with water at 180°F with a static differential pressure of approximately 110 inWC. The ID fan is rated at 19,000 acfm at 171°F and a differential pressure of 99.1 inWC. Each stage of the ID fan is powered by a 300-horsepower (hp), totally-enclosed, fan-cooled motor. The PCC combustion air blower and the SCC combustion air blower have nominal capacities of 4,000 acfm and 2,000 acfm, respectively, at 125 °F. Their design capabilities are 3,947 acfm at a differential pressure of 46.8 inWC, and 1,450 scfm at a differential pressure of 54 inWC.

2.6 DESCRIPTION OF WASTE FEED SYSTEMS

Two types of waste materials are fed to TOCDF LICs: mustard is fed to the PCC, and Decon is fed to the SCC.

2.6.1 Agent Collection and Feed System

The ACS receives, transfers, and stores agent drained from munitions and bulk containers. Agent received from the drain stations is transferred through the ACS to the agent holding tank until it can be pumped to the LIC for incineration. The equipment for the ACS is primarily located in the Toxic Cubicle (TOX). (Refer to Drawing TE-1-D-536 in Appendix H)

Agent quantities are determined by the Agent Quantification System (AQS) at the individual demilitarization machines (i.e., Rocket Shear Machine, Munitions Demilitarization Machine, Bulk Drain Station, and Mine Machine). Agent is pumped from these machines to the holding tank at a rate of approximately 15 gpm. ACS-TANK-101 is 3 ft 6 inches in diameter and 8 ft in height with a nominal volume of 500 gallons. ACS-TANK-102 is 4 ft 6 inches in diameter and 9 ft 6 inches in height with a nominal volume of 1,300 gallons. Agent in the ACS tanks can be mixed using the circulation pump, which is capable of withdrawing agent and then returning it to the same tank. Agent is drained by gravity flow from the tank through a suction strainer to agent feed pumps (ACS-PUMP)-101, -102, or -201, and then pumped to each LIC at a maximum rate of 2.00 gpm (1,275 lb/hr) for incineration. Before agent feed is started, all interlock requirements are met (i.e., the PCC temperature between 2,500°F and 2,850°F; SCC temperature between 1,800°F and 2,200 °F; LIC PAS normal; TOX normal; and burners firing). The control room operator then selects the agent feed rate setpoint and initiates agent feed. The Programmable Logic Controller (PLC) ramps the agent flow controller setpoint to the flow rate designated while simultaneously modulating the fuel gas flow rate to maintain the temperature setpoint. Redundant flow-indicating controllers control agent flow. The flow measured by two

separate flow elements is compared. If the difference is > 5%, the pump feeding the affected furnace is stopped, and the appropriate valves are closed.

2.6.2 Spent Decontamination Solution Feed System

The SDS collects and stores Decon from the decontamination of agent-contaminated equipment or personnel. The sump pumps transfer sump contents to one of three SDS storage tanks that are 6 ft in diameter and 10 ft 3 inches high, with a capacity of 2,300 gallons. When an SDS tank is filled, the Decon is sampled and analyzed for mustard, pH, density, and total organic compounds. If the mustard concentration is below 200 ppb, the Decon may be processed in the LIC. Decon is fed to the LIC SCC after the interlock requirements are met (i.e., the LIC PAS is normal, the SCC burner is firing, and the SCC exhaust temperature is above 1,800 °F). The Decon is pumped from the SDS tanks to the LIC SCC using feed pumps (SDS-PUMP)-171, -172, and -271. The valves are designed such that one tank may be emptied at a time and a tank being emptied cannot have Decon added to it. The third tank is always maintained at its low-level point to receive agent and Decon from possible spills of large quantities of agent.

2.7 DESCRIPTION OF SLAG REMOVAL SYSTEM

The salts in the Decon form a slag that collects at the bottom of the SCC, which is fitted with a Slag Removal System (SRS) that consists of a refractory-lined reservoir with a tap and drain. This reservoir, or slag pit, is 7 ft 2 inches in length by 2.0 ft in diameter for a total volume of 22.6 ft³. The slag pit temperature is maintained at > 1,400 °F by sleeved electric heaters to maintain slag liquidity for periodic draining. As necessary, the slag material is drained into drums that are removed for disposal. The SRS is not essential for operation of the SCC. Therefore, if it is out of service, the slag is allowed to build up until it reaches the bottom of the SCC exhaust duct. At that time, the LIC is shut down and the slag removed manually.

2.8 DESCRIPTION OF THE AUTOMATIC WASTE FEED CUTOFF SYSTEMS

The primary function of the AWFCO system interlocks is to prevent feeding hazardous waste if incineration conditions are outside the permit limits. The interlock system will automatically stop mustard and spent Decon feed and prevent restart until the incinerator is at proper operating conditions and the interlock is manually reset. When an AWFCO is activated, the process controller immediately increases natural gas feed to the PCC and switches from spent Decon feed to process water in the SCC. This maintains PCC and SCC temperatures until all wastes and waste residues exit the combustion chambers. Any residual agent in the LIC will be completely combusted by the residual heat in the PCC and the SCC.

Many of the LIC1 and LIC2 AWFCOs activate instantaneously when the measured value exceeds the setpoint. The conditions in the existing RCRA permit require instantaneous and HRA activation of all LIC AWFCO.

The AWFCO setpoints and the basis for their activation will be the same as required in the established RCRA Permit and/or the HWC MACT Notice of Compliance (NOC). Tables specifying the process control instruments that will be interlocked with the AWFCO system and their setpoints can be found in Appendix D. The DAQ and DSHW will be notified seven days in advance of the first AWFCO test before mustard is burned in the system. The AWFCO system will be tested every 14 days. A discussion of the LIC1 and LIC2 AWFCO parameters follows. (LIC2 instrument tag numbers are shown in parentheses.)

- PCC Exhaust Gas Temperature – The PCC gas temperature is monitored continuously at the exit of the PCC by a thermocouple and temperature indicating transmitter 13-TIT-610 (13-TIT-710). Agent and Decon feeds are stopped if the exit gas temperature falls below the low temperature setpoint on a HRA basis, or rises above the high temperature setpoint on an instantaneous basis.
- SCC Exhaust Gas Temperature – The temperature of the SCC exhaust gas is monitored continuously in the crossover duct by a thermocouple and temperature indicating transmitter 13-TIT-129 (13-TIT-782). The location of the thermocouple is close to the refractory ring. This location is selected because the volume created by the section of the crossover duct extending from the SCC to the refractory ring is included in the overall incinerator internal volume used to calculate residence time. Agent and Decon feeds are stopped if the exit gas temperature falls below the low temperature setpoint on a HRA basis, or rises above the high temperature setpoint on an instantaneous basis.
- Agent Feed Rate – Agent is pumped from the storage tanks to the PCC. The agent flow rate is continuously measured by two Corialis tube flow meters and flow indicating transmitters that are in series, i.e., 13-FIT-127A and B (13-FIT-731A and B). The value output by each transmitter is averaged by process control loop 13-FIC-127 (13-FIC-731). The AWFCO setpoint used to stop agent and Decon feed is based on the HRA agent feed rate.
- Decon Feed Rate – Decon is pumped from an SDS tank to the SCC. The Decon flow rate to the SCC is measured continuously by a flow meter and flow indicating transmitter 13-FIT-102 (13-FIT-763). The AWFCO setpoint used to stop Decon and agent feed is based on the HRA Decon feed rate.
- Agent Atomizing Air Pressure – A minimum air pressure is required to ensure complete atomization of the agent as it enters the combustion chamber. The PCC atomizing air pressure is measured continuously by 13-PIT-128 (13-PIT-736). Waste feeds to the LIC will be stopped if the atomizing air pressure falls below the setpoint.
- Decon Atomizing Air Pressure – A minimum air pressure is required to ensure complete atomization of Decon as it enters the SCC. This parameter is controlled by use of

pressure regulators and pressure switch 13-PS-058 (13-PS-809). Agent and Decon feeds are stopped if the Decon atomizing air pressure falls below the setpoint of the pressure switch.

- Agent Feed Nozzle Pressure at High Feed Rate – To ensure that the integrity of the agent gun nozzle is sufficient to cause atomization of the agent, the pressure at the agent nozzle is continuously measured by pressure element and pressure indicating transmitter 13-PIT-112 (13-PIT-760). If this pressure does not reach a minimum value within 10 seconds of starting the agent feed pump, and the agent feed rate is greater than 500 lb/hr, waste feeds to the LIC are stopped.
- Exhaust Gas Flow Rate – The pressure drop across a V-Cone® in the exhaust duct is measured and converted to an exhaust gas flow rate. The velocity pressure differential from the V-Cone® is continuously monitored by a pressure differential indicating transmitter, and a PLC uses these data to calculate the exhaust gas flow and sends the data to the Process Data Acquisition and Recording System (PDARS) as 24-FIT-9431 (24-FIT-9902). Waste feeds are stopped when the exhaust gas flow exceeds the setpoint established during the ATB on an HRA basis.
- Open Slag Discharge Gate – To prevent a direct path of exhaust gases to the LIC SCC Room, the slag discharge gate is equipped with position switch 13-ZS-367B (13-ZS-567B) to provide continuous indication of gate position status. Should this switch indicate anything other than the gate being closed, waste feeds to the LIC are stopped.
- SRS Shell Temperatures – Temperatures of the SRS shell are monitored by thermocouples and temperature indicating transmitters 13-TIT-374, -375, -376, and -377 (13-TIT-574, -575, -576, -577). Alarms 13-TAHH-374, -375, -376, and -377 (13-TAHH-574, -575, -576, and -577) provide information to the operators and the PDARS. Shell temperatures are monitored to prevent overheating of the slag reservoir shell with an incumbent loss of structural integrity. The LIC waste feed will stop automatically if the exterior shell temperature rises above 500°F.
- Quench Tower Exhaust Gas Temperature – The quench tower exhaust gas temperature is continuously monitored by thermocouple and temperature indicating transmitter 24-TIT-397 (24-TIT-816). High quench tower exhaust gas temperatures could result in failure of downstream process equipment and a safety hazard to personnel. High quench tower exhaust gas temperature is indicative of the loss of Brine flow or a plugged spray nozzle, which results in inadequate cooling of the exhaust gases. The LIC waste feeds are stopped if the quench tower exhaust gas exceeds the high temperature setpoint on a HRA basis.
- Brine Delivery Pressure – Quench Brine delivery pressure is continuously monitored by pressure element and pressure indicating transmitter 24-PIT-100 (24-PIT-838) at the

discharge of the Brine pump. Low Brine pressure is indicative of insufficient cooling of the exhaust gases. Waste feeds to the LIC are stopped if measured pressure falls below the setpoint on an instantaneous basis.

- Brine Flow to the Venturi Scrubber – The Brine flow to the venturi scrubber is continuously monitored by flow sensor and flow indicating transmitter 24-FIT-088 (24-FIT-828). Adequate Brine flow to the venturi scrubber is essential for proper scrubbing of the exhaust gases. Waste feeds to the LIC are stopped if the measured value falls below the setpoint on a HRA basis.
- Venturi Scrubber Differential Pressure – The differential pressure across the venturi scrubber is continuously monitored by pressure differential indicating transmitter 24-PDIT-090 (24-PDIT-814). Waste feeds are stopped if the measured value falls below the setpoint on a HRA basis.
- Brine Density – High Brine density could lead to reduced flows, clogging of nozzles, and formation of solid deposits in system piping. Brine density is monitored by density probe and density indicating transmitter 24-DIT-083 (24-DIT-835) and provides the input to process controller 24-DIC-083 (24-DIC-835). If the Brine density exceeds the 12-hr rolling average setpoint, waste feeds to the LIC are stopped.
- Clean Liquor Density – High clean liquor density could lead to reduced flows, clogging of nozzles, and formation of solid deposits in system piping. Clean liquor density is measured continuously by density probe and density indicating transmitter 24-DIT-117 (24-DIT-826) and provides the input to process controller 24-DIC-117 (24-DIC-826). If the clean liquor density exceeds the 12-hour rolling average setpoint, waste feeds to the LIC are stopped.
- Clean Liquor Flow Rate – Clean liquor is added to the top of the packed bed scrubber by pumping fluid through distribution trays over the top of the pall rings. The clean liquor flow rate to the packed bed scrubber sprays is continuously monitored by flow sensor and flow indicating transmitter 24-FIT-112 (24-FIT-825). Waste feed is stopped if the flow rate to the packed bed scrubber tower sprays falls below the setpoint on a HRA basis.
- Clean Liquor Delivery Pressure – Clean liquor pressure is measured continuously by pressure sensor and pressure indicating transmitter 24-PIT-129 (24-PIT-839) at the clean liquor pump discharge. A low pressure is indicative of pump or piping failure or break through of one or more packed bed sections, thus affecting the effectiveness of the scrubber tower in removing pollutants. If the measured clean liquor delivery pressure falls below the setpoint, waste feeds to the LIC are stopped.
- Brine pH – The Brine pH is monitored continuously by pH probes and analyzer indicating transmitters 24-AIT-091A and B (24-AIT-831A and B) to ensure the Brine

remains alkaline. One probe is active at a time and provides the input to the PLC. Waste feeds are stopped if the measured value falls below the setpoint on a HRA basis.

- Clean Liquor pH – The pH of the clean liquor is monitored continuously by pH probes and analyzer indicating transmitters 24-AIT-116A and B (24-AIT-832A and B) to ensure that the clean liquor remains alkaline. One probe is active at a time and provides the input to the PLC. Waste feeds are stopped if the measured value falls below the setpoint on a HRA basis.
- Scrubber Tower Bed Differential Pressure – The pressure differential of the scrubber tower is monitored continuously by 24-PDIT-108 (24-PDIT-822). Waste feeds are stopped if the measured value falls below the setpoint on a HRA basis.
- High Blower Exhaust CO Concentration – The CO concentration is continuously measured at the ID fan discharge by CO CEMS and recorded by PDARS as 13-AIT-083 and 24-AIT-078 (13-AIT-778 and 24-AIT-716). The CO AWFCO will stop waste feeds to the LIC if the HRA CO concentration exceeds the permitted value corrected to 7% O₂, dry basis. The O₂ correction factor will be calculated using the following equation:

$$CO_c = CO_m \times \frac{14}{(21 - O_{2m})}$$

where:

- CO_c = the exhaust gas CO concentration corrected to 7% O₂, dry basis
- CO_m = the measured exhaust gas CO concentration, dry basis
- O_{2m} = the measured exhaust gas O₂ concentration, dry basis

- Blower Exhaust Gas O₂ Concentration – The O₂ concentrations are monitored continuously at the ID fan discharge by O₂ CEMS recorded by PDARS as 13-AIT-229 and 24-AIT-210 (13-AIT-798 and 24-AIT-717). If O₂ concentrations fall below the minimum setpoint or rise above the maximum, waste feeds to the LIC are stopped.
- LIC Exhaust Gas Agent Concentration – The exhaust gas ducts of the four TOCDF incinerators discharge their exhaust gases to the atmosphere through a common stack. Concentrations of mustard in the exhaust gas in the duct between the ID fan and the common stack (LIC duct) are measured using ACAMS during long-term operations. Two mustard ACAMS will be in each duct with one operating and the other in standby mode. The LIC duct ACAMS are designated PAS 704 (PAS 705). Three ACAMS will be used to provide continuous monitoring in the LIC Duct during this ATB. The ACAMS sampling cycles (sample collection followed by sample desorption and analysis) are adjusted so that one ACAMS is collecting an exhaust gas sample while the second is analyzing an exhaust gas sample. One ACAMS is used for backup and is brought online during challenges or malfunction of one of the other ACAMS. The ACAMS data is

electronically recorded each time a change in exhaust gas agent concentration is measured. Waste feed to the LIC will be stopped if either of the on-line ACAMS measures a concentration of agent in the exhaust gas that equals or exceeds the setpoint.

- **Common Stack Exhaust Gas Agent Concentration** – The agent concentrations in the combined exhaust gases of all four TOCDF incinerators are continuously monitored in the common stack. The operation of the ACAMS and those ACAMS in use during the LIC Mustard ATB will be controlled by Attachment 22 to the TOCDF RCRA Permit (7). To monitor for Agents GB, VX, and mustard would require nine ACAMS: three ACAMS are used to monitor for Agent GB (PAS 701 series); three ACAMS are used to monitor for Agent VX (PAS 706 series); and three ACAMS monitor for mustard (PAS 707 series). Their sequenced, or staggered, operation is similar to that described previously. Waste feed to all incinerators is stopped if either of the on-line ACAMS measures a concentration of agent in the exhaust gas that equals or exceeds the setpoint.
- **Brine Surge Tanks Full** – Brine purged from the PAS of each of the four TOCDF incinerators are mixed together and piped to one of four storage tanks. The liquid level in each of these four tanks is continuously monitored. Activation of a level switch causes the tank's inlet valve to close when it is full. Waste feed to all four incinerators is stopped if all four storage tanks are full. The high-high level switch alarms associated with the four tanks are 23-LSHH-002, 23-LSHH-006, 23-LSHH-702, and 23-LSHH-706.

The TOCDF control system is designed to minimize AWFCOs and ensure that the system is in compliance. When an instrument fails, it usually will go out of range, which creates an alarm to the process control system to alert the operator of the problem. The TOCDF control system monitors critical functions and gives advanced warnings, using pre-alarms where possible, which indicates that an alarm condition is developing. Advanced warnings give operators time to take corrective actions before operations necessitate an AWFCO.

The measurement devices that initiate AWFCOs are calibrated and maintained on a regular basis as directed by TOCDF procedures. Most instruments are calibrated on a 180-day schedule. The pH meters, 24-AE-091 (24-AE-831), are calibrated on a weekly basis. The CEMS are checked on a daily basis and undergo an annual Performance Specification Test (PST).

2.9 EXHAUST GAS MONITORING EQUIPMENT

Exhaust gases from the LICs are monitored on a continuous basis. Each LIC has a CEMS for monitoring CO and O₂. Agent monitoring systems located in each LIC duct monitor for mustard. Two CO and O₂ instruments are used with one designated the primary CEMS and the other the backup CEMS. For these parameters, the AWFCO will be activated when either properly functioning CEMS detects conditions beyond the setpoints. Outputs from these monitors are sent to PLCs, which display the results in the control room, calculate rolling averages, and archive the data in PDARS for future reference.

2.9.1 Continuous Emissions Monitoring Systems

A separate CEMS is used to monitor the exhaust gas concentrations of CO and O₂ for each of the LICs. The CEMS will meet all of the performance specifications detailed in “Standards of Performance for New Stationary Sources” (8). Permanently installed CEMS probes are located in the LIC duct between the ID fan and the common stack. The probes supply exhaust gas to the analyzers dedicated to monitoring the LIC exhaust gas.

The primary functions of the CEMS are to continuously measure, display, and record the gas concentrations in the LIC duct. Output from the CEMS will activate alarms and interrupt waste feed when preset values are exceeded. The CEMS data are recorded in PDARS. The CEMS will remotely display gas compositions and CEMS operational status. The LIC CEMS instrumentation is located in a climate-controlled monitoring room, which is located next to the LIC ducts in the PAS area.

The PLC transmits data to the PDARS, which provides remote data recording of CEMS operations at the plant Control Room (CON). All analog and digital input/output signals will be conditioned properly to reduce noise and isolate signals from voltage transients. The PDARS displays and records the uncorrected and rolling averages for the gas concentrations, which are updated at least every 15 seconds. The PLC activates alarms and initiates an AWFCO when high CO, low O₂, or high O₂ concentrations are detected in the exhaust gas or when the PDARS experiences a loss of analyzer signal.

The exhaust gas sample enters the CEMS through a probe assembly located in the LIC duct. The sample is then drawn through a heated line to the sample conditioning system where it is prepared for analysis in the analyzers.

2.9.1.1 Carbon Monoxide Monitors

The CO analyzers are identified by PDARS as 13-AIT-083 and 24-AIT-078 (13-AIT-778 and 24-AIT-716), and they are Teledyne, Advanced Pollution Instrumentation Division Model 300EM non-dispersive infrared (NDIR) analyzers as described in 40 CFR 60, Appendix A, Method 10 (2). The analyzers are calibrated on two ranges according to the CEMS Monitoring Plan, Attachment 20 (3) within the expected concentration ranges for the incinerator. These calibrations include analyses of a zero gas and a span calibration gas. The CO monitor sends a reading to a PLC every 15 seconds. The readings are averaged over one minute by the PLC. The PLC calculates a HRA from the one-minute averages. The averages are sent to the PDARS. The 40 CFR 60, Appendix B, Performance Specification 4B, is used to evaluate the CO CEMS performance and determine if the CO CEMS meets the calibration drift requirements. The CO CEMS initiates an AWFCO when either independent analyzer detects CO concentrations higher than the setpoint. If one CO monitor fails or is taken off-line, the data from the other CO monitor will be used to verify that the system is operating correctly. If both CO monitors fail, an AWFCO will be initiated.

The NDIR analyzer's specifications are as follows:

- Range: 0-200, 0-5000 ppm
- Accuracy: $\pm 1\%$ of full scale
- Drift: $< 1\%$ of full scale per week
- Reproducibility: 0.5% of reading
- Response time: < 60 seconds

The CO CEMS are drift checked daily. Gases of 0 to 2%, and 60 to 90% of instrument span are used to calibrate and drift check the CO analyzers. Calibration gases are injected into the sampling system at the duct. Gases will be injected by opening the solenoid valve on each certified gas standard cylinder to allow the reference gas to flow under pressure to the sample probe. The reference gas is drawn through the sample transport, sample conditioning, and sample delivery system and is analyzed in the same manner as an exhaust gas sample. Calibration results are stored and printed through the PDARS. The concentrations of the reference gases span the expected concentrations of the exhaust gas. The span gas calibrations are considered a verification of the quality of the CEMS data.

2.9.1.2 Oxygen Monitors

The O₂ analyzers are identified by PDARS as 13-AIT-229 and 24-AIT-210 (13-AIT-798 and 24-AIT-717), and they are Ametek, Thermox Instrument Division FCA zirconium oxide electrochemical detectors. The analyzers are calibrated according to the CEMS Monitoring Plan, Attachment 20 to the TOCDF RCRA permit (3), using a zero gas and span calibration gases. The 40 CFR 60, Appendix B, Performance Specification 3 (9) is used to evaluate the O₂ CEMS.

The Thermox® Ametek® FCA analyzer's specifications are as follows:

- Range: 0-25 Volume %
- Accuracy: $\pm 2\%$ of full scale
- Drift: Less than 0.1% of cell output per week
- Reproducibility: $\pm 0.2\%$ of measured value
- Response time: 90% of step change in 5 seconds

The O₂ CEMS are calibrated daily using a two-point calibration method. Gases of 0 to 2% and 60 to 90% of instrument span are used to calibrate the O₂ analyzers. Calibration gases are injected into the sampling system at the duct. Gases will be injected by opening the solenoid valve on each certified gas standard cylinder to allow the reference gas to flow under pressure to the sample probe. The reference gas is drawn through the sample transport, sample conditioning, and sample delivery system and is analyzed in the same manner as an exhaust gas sample. Calibration results are stored and printed through the PDARS. The concentrations of the reference gases span the expected exhaust gas concentrations. The span gas calibrations are considered a verification of the quality of the CEMS data.

2.9.2 Agent Monitoring Systems

Operations of the agent monitoring systems are discussed in Attachment 22 to the TOCDF RCRA Permit (7). Agent concentrations in the plant and in the exhaust gas are monitored using ACAMS and DAAMS. Agent monitoring during the Mustard Agent Campaign will be controlled by Attachment 22 (7) and it may include multi-agent monitoring. The LIC rooms and LICs are not considered potential Agent VX areas because they will only process mustard or liquids that have contacted mustard. Agent VX ACAMS will not be used in the LIC ducts. These systems have undergone extensive testing and evaluation under both simulated and actual field conditions. Testing and evaluation of the mustard monitoring systems will be provided to the DAQ and the DSHW prior to the shakedown period.

Operations of the ACAMS and DAAMS are controlled by LOPs. These systems use gas chromatographs (GC) for the detection of mustard.

Exhaust gases are monitored on a continuous basis to ensure chemical agents are not released to the environment. An AWFCO will be initiated if an ACAMS alarm occurs in the LIC duct (PAS 704 or 705) or the common stack (PAS 707 for mustard, PAS 701 for Agent GB and PAS 706 for Agent VX). ACAMS alarms on the LIC duct and the common stack are the only ACAMS that will impact sampling directly. If PAS 704 (705) or PAS 701/706/707 ACAMS alarm or malfunction, sampling will cease.

A malfunction is different than an alarm; a technician responds to a malfunction to determine whether the ACAMS is actually malfunctioning. If a malfunction is found, the DAAMS tubes will not be analyzed. Feed to the LIC will resume and sampling will resume when the LIC reaches steady state operations.

There are several scenarios of alarm. When an ACAMS alarms, DAAMS tubes are analyzed for verification. The first alarm scenario involves only an ACAMS alarm in the duct, and sampling will cease. The DAAMS tubes from the duct and the stack will be analyzed. If agent is confirmed, the test will terminate; if agent is not confirmed, feed will resume. Sampling will resume when the LIC has stabilized. A second scenario is an ACAMS alarm where only the stack ACAMS alarms. The DAAMS tubes from the common stack and all duct stations are analyzed. If agent is confirmed, the test is terminated; if no agent is confirmed, feed will resume, and sampling will resume when the LIC has stabilized. A third scenario is ACAMS alarming at both locations. In this case, the DAAMS tubes from the stack and the duct are both analyzed. If agent is confirmed in either set of DAAMS tubes, the test is terminated. If no agent is confirmed, feed will resume, and sampling will resume when the LIC has stabilized. The precision and accuracy of each monitoring system is determined through actual on-site testing after installation of the equipment and then checked at periodic intervals. These data are used to establish quality control (QC) bounds, calibration and challenge frequencies, and procedures. These challenge frequencies and procedures are then delineated in a system QC plan.

2.9.2.1 Automatic Continuous Air Monitoring System

The ACAMS provides quantitative agent data and is capable of detecting mustard at the Immediately Dangerous to Life or Health (IDLH) (high level) and the Short Term Exposure Limit (STEL) limits (low-level) set by the U.S. Surgeon General for unmasked workers, or the Source Emission Limit (SEL) level. Operation of the ACAMS is covered in TE-LOP-524.

The ACAMS represents state-of-the-art instrumentation for the detection and quantification of chemical agents in workplace environments and furnace exhaust gas. These two environments are substantially different in their composition and potential interferences. Exhaust gases are difficult to sample because of high temperatures and high-moisture contents. The ACAMS Dilution Air Flow Controller (ADAFc) is used in conjunction with the ACAMS to allow sampling directly from a duct. The ADAFc provides more accurate and reproducible results by conditioning the exhaust gas prior to sampling and analysis.

The ADAFc mixes instrument air with the exhaust gas sample before it enters the ACAMS. Mustard operations require the gas entering the ACAMS to be composed of 5% exhaust gas and 95% instrument air. The instrument air lowers the dew point of the sampled gas, thereby preventing moisture from condensing in the sample lines or the ACAMS. The ADAFc maintains a constant ratio of instrument air to exhaust gas. A constant ratio is necessary to allow the ACAMS software to accurately quantify any agent present. When analyzing agent concentrations in the SEL or STEL modes of operation, the ACAMS uses a formula based on a measurement of total sample flow over a given amount of time. When an ADAFc is added to the system, the ACAMS measures a total sample volume (sample flow rate multiplied by the sample time) that is 20 times the actual sample volume from the duct. The concentrations of the calibration standards compensate for this dilution.

The ratio of dry air to sample must remain constant in order for the reported concentrations to remain accurate. These flows are monitored automatically and prompt a malfunction alarm if flows drift out of tolerance. These flows will be verified with a calibrated flow controller at the beginning and end of each run for this ATB. There are two instruments used to measure the flow of the sample stream (5%) and the dilution stream (95%). The 5% flow is measured with a 0.5 liters per minute (L/min) flow instrument with an accuracy of $\pm 2\%$ of full scale [± 10 milliliters per minute (mL/min)]. The 95% flow is measured with a 2 L/min flow instrument with an accuracy of $\pm 2\%$ of full scale (± 40 mL/min.). The DAQ and DSHW will be notified when the instrument air ratio will be verified so that they may observe the test.

The evaluation and testing program for these units in the field is rigorous. Precision and accuracy data are generated while sampling actual exhaust gases during non-agent operations. The Limit of Quantification (LOQ) of the ACAMS at the SEL level is 0.006 mg/m^3 mustard. Testing and evaluation in all agent modes have been completed, and all monitors met the 95% confidence level for $\pm 25\%$ accuracy.

The ACAMS consists of a sampling pump, a sample collection module, a Gas Chromatograph with a Flame Photometric Detector (GC/FPD), a monitor with strip chart recorder, and a computer interface module for automated data acquisition. The ACAMS uses the GC column to separate other compounds from agent and the selectivity of its FPD to improve the specificity of the response to chemical agents. The ACAMS provides quantitative agent data.

The ACAMS cycle time in the mustard mode will be five minutes based on testing results. This cycle time is divided into a sample collection period and a purging and analysis period. To provide continuous mustard monitoring of the exhaust gas during the ATB, there will be two ACAMS on-line and one backup at the LIC Duct sample location and at the common stack. The instruments will be cycled so that one ACAMS will sample the gas at each location while the second ACAMS is in the purge/analysis mode. If the stack ACAMS cycle times are not in the correct sequence, an alarm and an AWFCO will be activated. The sequencing of the ACAMS in the LIC duct will be checked hourly during the LIC Mustard ATB. The third ACAMS is held in reserve to be used if an ACAMS fails. This additional ACAMS also allows the other ACAMS to be challenged off-line without affecting the ability to monitor the exhaust gas continuously.

2.9.2.2 Depot Area Air Monitoring System

The DAAMS is a sampling and analysis technique capable of detecting Agents GB, VX, and mustard in ambient air at the STEL limits established by the U.S. Surgeon General for unmasked workers. TE-LOP-522 and TE-LOP-562 cover collection and analysis of samples, respectively, on the DAAMS tubes. A DAAMS sampling station is located at the LIC duct and the common stack near the ACAMS sampling points. The agents monitored will be controlled by Attachment 22 (7)

A DAAMS Dilution Air Flow Controller (DDAFC) conditions the exhaust gases sampled by the DAAMS. The DDAFC lowers the gas dew point to improve collection efficiency for organic compounds on the DAAMS tube sorbent bed for subsequent analysis. The DDAFC operates like the ADAFC (i.e., the flow through a DAAMS tube is controlled to maintain 5% exhaust gas and 95% instrument air). The “worst-case” flow rate from the DDAFC is used in the calculation of total flow to the DAAMS tubes. The Chemical Assessment Laboratory (CAL) will analyze the DAAMS tubes. The LOQ for a DAAMS tube analysis is about 6.0×10^{-9} mg/m³ mustard or a factor of about 68 less than the SEL.

The exhaust gas flow and the instrument airflow are verified with calibrated flow controllers once per day. The 5% flow is measured with a 0.5 L/min instrument accurate to $\pm 2\%$ of full scale (± 10 mL/min). The 95% volume is measured with a 10 L/min instrument accurate to $\pm 2\%$ of full scale (± 200 mL/min). During the trial burn, each DAAMS set will be leak checked after placement in the sampler. The DDAFC exhaust gas and instrument airflows will be verified at the beginning and the end of each trial burn run. The worst case for flows will be used to calculate the mass of mustard exiting the system for the DRE calculations. The DAQ and DSHW will be notified when the instrument air ratio will be verified so they may observe the test.

A Quality Plant sample (QP) is a field surrogate sample. A QP will be run with each DAAMS set during this ATB to verify that agent is not lost from the DAAMS tubes during sample collection. The QP sample is a DAAMS tube spiked with mustard before sample collection.

The DAAMS tubes will be used to determine the agent concentrations used in the DRE calculation for the trial burn. In the case of an ACAMS alarm, the sample time used to calculate the DAAMS concentration will equal the time the ACAMS is in alarm. If the normal DAAMS sample period ends during the alarm condition, the sampling period will be extended until the ACAMS clears to avoid missing any mustard in the exhaust gas. The DAAMS sampling period for the mustard ATB DRE will be about one hour unless there is an agent alarm.

2.10 POLLUTION ABATEMENT SYSTEM

The LIC PAS equipment includes:

- Quench tower
- Venturi scrubber
- Scrubber tower
- Demister
- ID fan
- Duct to the common stack

Drawings and P&IDs for the PAS are provided in Appendices G and H.

The quench tower serves four primary purposes, which include:

- Cooling the SCC exhaust gas to protect downstream PAS devices.
- Providing a contact chamber for PM and acid gas removal.
- Saturating the exhaust gas to optimize the performance of the venturi scrubber.
- Rapidly reducing exhaust gas temperature to reduce PIC-formation potential in the PAS.

Exhaust gases travel from the SCC to the quench tower, where they travel through a series of Brine sprays that cool the gases by evaporating water. Brine from the scrubber tower reservoir is supplied to the quench tower by the quench brine pump. Brine is sprayed into the top of the tower at a rate in excess of the maximum expected evaporation load. The excess water drains from the quench tower back to the scrubber tower reservoir. The quench brine pump discharges through strainers where large PM are removed. The water required to maintain the level in the scrubber tower reservoir is added to the brine pump discharge upstream of the quench tower spray nozzles.

The saturated exhaust gas stream will exit the quench tower and enter the high-energy venturi scrubber, which is designed for high-efficiency PM and acid gas removal. The exhaust gases contact a controlled flow of Brine to form droplets that coalesce or combine in the venturi scrubber throat to remove sub-micron PM and neutralize acid gases. The venturi scrubber has a variable throat controller that may be set within the range of 20-50 inWC across the throat. Sodium hydroxide (18% NaOH) is added to the Brine as required to maintain a pH of 7 or above in the scrubber tower reservoir. Exiting the venturi scrubber, the exhaust gas stream flows through a 90° elbow before entering the scrubber tower reservoir. As the stream traverses the elbow, PM and water droplets are forced to the bottom of the duct and drain into the reservoir.

The two-phase (gas and liquid) effluent from the venturi scrubber enters the scrubber tower. The liquid falls to the scrubber tower reservoir while the gas rises through the chimneys of the clean liquor tray. The clean liquor pump circulates clean liquor from the bottom of the clean liquor tray to the top of the packing. The pH and density of the clean liquor are adjusted by adding NaOH or water depending on conditions. The rising gas contacts this scrubbing solution in the packed bed, such that acid gases are absorbed by the solution and neutralized. Circulation of solution is controlled to ensure adequate contact between liquid and gas at the maximum expected gas flow. Gases rising from the packed bed pass through a mist eliminator that causes liquid droplets to coalesce and drain to the reservoir tray in the packed bed.

Clean liquor pH is adjusted by adding 18% NaOH. When water or NaOH are added, excess clean liquor overflows the clean liquor tray through the chimneys and falls into the scrubber tower reservoir, where it becomes Brine. Brine is circulated to the venturi scrubber and quench tower. The pH readings of the quench Brine and the clean liquor are recorded by PDARS.

Density is monitored in the pump discharge lines of the Brine loop and the clean liquor loop. The density meter in the Brine loop generates a proportional signal that modulates a control valve to transfer Brine to the holding tanks in the Brine Reduction Area (BRA). As Brine is discharged, process water is added to maintain the liquid level and decrease the density. The transfer of Brine continues until the density drops below the setpoint. (Brine is managed as an F999 waste as described in the TOCDF RCRA Permit Waste Analysis Plan.) Water is also added to the clean liquor loop to reduce density. The added water causes the fluid levels to rise and overflow the chimneys into the scrubber tower reservoir. The density of the Brine and clean liquor are recorded by PDARS.

The scrubber tower effluent enters the demister to complete removal of entrained solids and liquid droplets. The gas enters at the bottom and flows upward through and around candles that strip entrained moisture and solids. The solids remain on the candles. Liquid accumulates in the vessel bottom and is pumped to the scrubber tower reservoir. Each LIC PAS includes a dedicated demister and a shared spare. The spare is located between the LIC1 PAS and the LIC2 PAS. The spare allows replacement of the demister candles without significantly affecting operations. Only one LIC may be lined up to use the spare demister at any time. An

atmospheric bleed damper is located just before the demister to prevent the ID fan overheating during startup. This damper is manually locked closed and covered during agent operations.

Exhaust gases travel from the demister to the ID fan. This fan is the prime mover of exhaust gases through the system. In conjunction with its suction side damper, it controls the pressure inside the incinerator. The pressure is sensed at the PCC and controlled at a negative pressure with respect to the LIC primary chamber furnace room. The PCC differential pressure sensor modulates the damper on the suction side of the fan. Once through the ID fan, the exhaust gases are above atmospheric pressure as they enter the duct to the common stack manifold and into the common stack. The O₂ and CO CEMS, the LIC duct ACAMS, and the sampling ports used for this ATB are located in the duct between the ID fan and the common stack.

Operating information for major PAS components are:

- Quench Tower – The quench tower contains spray nozzles to cool and humidify exhaust gases to saturation. The gas outlet temperature will be approximately 200 °F. The total Brine flow rate to all nozzles will be about 90 gpm. The quench tower is 6 ft in diameter and 40 ft high with a conical top and bottom. It drains to the scrubber tower reservoir.
- Venturi Scrubber – The venturi scrubber is an Anderson 2000 Inc., variable-throat venturi. The Brine flow rate to the venturi is about 120 gpm. The differential pressure across the LIC PAS venturi scrubber is normally about 45 inWC. The scrubber solution to the venturi scrubber will be pH-controlled with 18 % NaOH. The pH setpoint will be maintained at 7 or higher.
- Scrubber Tower – The scrubber tower performs three functions. First, it provides a nominal, 135-ft³ reservoir for Brine at the lower end. Second, the midsection holds a clean liquor reservoir and a packed bed of pall rings. Clean liquor flows over the pall rings to remove acid gases and PM from the exhaust gases. Third, the upper end contains a mist eliminator, which removes entrained moisture from the gases as they exit the tower. A minimum of 20 inches of Brine is maintained in the reservoir to ensure adequate prime for the quench Brine pumps. Clean liquor flow to the packed bed chimneys is about 500 gpm. The scrubber tower is 5 ft 6 inches in diameter and 40 ft high with a conical top and bottom.
- Demister – This cylindrical fiberglass vessel contains multiple candle structures that remove moisture and entrained solids from the gas stream passing up through them. The moisture falls to the bottom of the demister and is pumped to the scrubber tower reservoir. LIC1 and LIC2 share a spare demister to allow candle change-out with minimal impact on operations. The demister is 11 ft in diameter and 31 ft high with a conical bottom.
- ID fan – The LIC incineration system prime mover is a 2-stage Robinson Industries Inc., Model 5800, centrifugal fan. The fan is designed to maintain a negative pressure in the

LIC and PAS and is rated for an inlet gas flow of 19,000 acfm at 171 °F with an induced draft of 99.1 inWC. Each stage of the ID fan is powered by a 300 hp induction motor.

- Quench Brine System – The system is the network of pumps, valves, and piping that collects drainage from the quench tower and demister, transfers it into the scrubber tower reservoir, and pumps Brine to sprays in the quench tower and scrubber solution for the venturi scrubber. Two 221-gpm brine pumps and a 24-gpm demister water return pump are the prime movers of Brine through the system. The system also controls scrubber tower level, Brine pH, and Brine density through its instrumentation and control valves.
- Clean Liquor System – The system is the network of pumps, valves, and piping that provides the scrubber solution for the packed bed chimneys in the scrubber tower. One of two 859-gpm clean liquor pumps draws from the trays beneath the chimneys and discharges clean liquor over the tops of the packed bed. The system also controls clean liquor level, pH, and density through its instrumentation and control valves.

2.11 CONSTRUCTION MATERIALS

The construction materials for the incinerator system components are listed in Table 2-1.

TABLE 2-1. LIQUID INCINERATOR CONTRUCTION MATERIALS

COMPONENT	CONSTRUCTION MATERIAL
Primary Combustion Chamber	SR90 Refractory-lined (aluminum silicate up to 52%; crystalline silica up to 52%) carbon steel
Primary Combustion Air Blower	Carbon steel
Secondary Combustion Chamber	Ruby SR Refractory-lined (alumina up to 50%, amorphous silica up to 40%) carbon steel
Secondary Combustion Chamber Air Blower	Carbon steel
Quench Tower	Hastelloy® C
Venturi Scrubber	Hastelloy® C
Scrubber Tower	Hastelloy® C
Demister	Fiberglass-reinforced plastic with Nexus coating
Induced Draft Fan	Type 316 stainless steel hub and shaft, ASTM A 240 Alloy 255 wheel, epoxy-coated carbon steel housing
Quench Brine Pumps	Hastelloy® C
Clean Liquor Pumps	Type 316 stainless steel
Demister Water Return Pump	Type 316 stainless steel

2.12 LOCATION AND DESCRIPTION OF TEMPERATURE, PRESSURE, AND FLOW INDICATING AND CONTROL DEVICES

This section provides a general description of temperature, pressure, flow, and other instrumentation necessary to ensure compliance with all permit conditions. A discussion of the major controls of the LIC is also provided. The locations of the process control instruments are shown on the drawings provided in Appendices G and H. These appendices also show the instruments that are used to monitor plant operations, record data for the facility operating record/ATB, and list the alarm settings for key process monitoring equipment.

The control system has a centralized control console, including closed-circuit television monitors (for observing operations at various locations), and locally mounted PLCs. Most processing and sequencing operations are controlled automatically through the PLCs. Interlocks are provided to prevent improper facility operation. These interlocks are monitored and continuous checking is undertaken to determine any failure to complete a programmed step. The PDARS logs abnormal conditions, operator entries into the system, and starting and stopping of equipment with the time of occurrence. The control system provides continuous automatic control of the incineration process. In monitoring critical functions, the process control system gives advanced warnings using pre-alarms where possible, indicating that an alarm condition is developing, which warns operators in time to take corrective action.

The proper operation of this monitoring and control equipment is necessary to ensure consistent compliance with all permit conditions and safe, efficient operation of the LIC. Although all process monitoring instrumentation receives periodic maintenance, equipment critical to compliance with permit operating conditions receives additional attention. Key issues associated with these instruments include:

- Continuing and preventive maintenance
- Verification of instrument calibration
- Verification of AWFCO integrity

The preventive maintenance program is supported by information received from daily and periodic inspections of the process equipment. Instrument calibration and preventive maintenance are performed following the procedures and frequencies shown in Table 2-2. A description of the most significant control loops follow.

TABLE 2-2. INSTRUMENT CALIBRATION FREQUENCY

Item	Instrument Tag Identification	Instrument	Calibration Frequency (days)
1	13-FIT-127A (731A)	Agent Feed Rate to Primary Chamber	180
2	13-FIT-127B (731B)	Agent Feed Rate to Primary Chamber	180
3	13-PIT-128 (736)	Agent Feed Atomizing Air Pressure	180
4	13-PIT-112 (760)	Agent Gun Nozzle Pressure	180
5	13-TIT-610 (710)	Primary Chamber Gas Temperature	180
6	13-TSHH-610 (710)	Primary Chamber Gas Temperature Switch High-High (AWFCO)	360
7	13-FIT-102 (763)	Secondary Chamber Decon/Process Water Feed Rate	180
8	13-PSL-058 (809)	Secondary Chamber Atomizing Air Pressure Low (AWFCO)	180
9	13-TIT-129 (782)	Secondary Chamber Gas Temperature	180
10	13-TSHH-129 (782)	Secondary Chamber Gas Temperature Switch High High (AWFCO)	360
11	13-FIT-9431 A & B (9902 A & B)	V-Cone Exhaust Gas Flow Rate	360
12	24-PIT-9431 (9902)	V-Cone Pressure	180
13	24-TIT-9431 (9902)	V-Cone Temperature	180
14	24-TIT-397 (816)	Quench Tower Gas Temperature	90
15	24-TSHH-089 (800)	Quench Tower Gas Temperature Switch High-High (AWFCO)	360
16	24-PIT-100 (838)	Quench Brine Delivery Pressure	180
17	24-FIT-088 (828)	Quench Brine Flow to Venturi Scrubber	180
18	24-PDIT-090 (814)	Venturi Scrubber Pressure Drop	360
19	24-FIT-112 (825)	Scrubber Tower Liquid Flow Rate	180
20	24-PIT-129 (839)	Scrubber Tower Liquid Delivery Pressure	180
21	24-AIT-091A (831A)	Brine Sump Liquid pH	7
22	24-AIT-091B (831B)	Brine Sump Liquid pH	7

TABLE 2-2. INSTRUMENT CALIBRATION FREQUENCY (continued)

Item	Instrument TAG Identification	Instrument	Calibration Frequency (days)
23	24-AIT-116A (832A)	Clean Liquid pH	7
24	24-AIT-116B (832B)	Clean Liquid pH	7
25	24-DIT-083 (835)	Brine Sump Liquid Density	180
26	24-DIT-117 (826)	Clean Liquid Density	180
27	24-PDIT-108 (822)	Scrubber Tower Bed Differential Pressure	180
28	24-AIT-078 (716)	Exhaust Gas CO Concentration	Daily
29	24-AIT-083 (778)	Exhaust Gas CO Concentration	Daily
30	24-AIT-210 (717)	Exhaust Gas O ₂ Concentration	Daily
31	13-AIT-229 (798)	Exhaust Gas O ₂ Concentration	Daily
32	PAS-704 (705)	PAS Blower Exhaust Gas Mustard Agent Concentration	Daily
33	PAS-701G/706V/707H	Common Stack Exhaust Gas Agent Concentration	Daily 4 hr for VX
34	13-TIT-374 (574), 13-TIT-375 (575), 13-TIT-376 (576), 13-TIT-377 (577)	Secondary Chamber Slag Removal System Shell Temperature	180
35	ZS-367B (567B)	Secondary Chamber Slag Gate Open Limit Switch (AWFCO)	Not Applicable

Note: AWFCO = Automatic Waste Feed Cutoff

2.12.1 Primary Combustion Chamber Agent Feed Rate Control

The flow of agent to the LIC PCC burner will be monitored constantly by means of mass flow meters 13-FIT-127A and 127B (13-FIT-731A and 731B) on the agent feed line. Their measurements are totaled by 13-FQI-127A and 127B (13-FQI-731A and 731B), averaged by 13-FY-127 (13-FY-731) and the result compared to setpoint by 13-FIC 127 (13-FIC-731). 13-FIC-127 (13-FIC-731) then drives control valve 13-FV-127 (13-FV-731) to the appropriate position for the flow desired. If flows, as measured by 13-FQI-127A and 127B (13-FQI-731A and 731B), differ by more than 5%, 13-FDAH-127 (13-FDAH-731) will trip.

2.12.2 Primary Combustion Chamber Pressure Control

The differential pressure between the LIC furnace room and the PCC is monitored constantly by means of pressure transmitter 13-PIT-052 (13-PIT-706) mounted near the top of the PCC. Pressure controller 13-PIC-052 (13-PIC-706) sends a signal 13-PV-052 (13-PV-706) located near the suction of the LIC ID fan. 13-PIC-052 (13-PIC-706) thereby modulates 13-PV-052 (13-PV-706) to maintain the PCC at least 0.5 inWC more negative than the LIC furnace room. High-high PCC pressure switch 13-PSHH-233 (13-PSHH-845) actuates alarm switch 13-PAHH-233 (13-PAHH-845). A continuous record of the PCC pressure is maintained by PDARS through 13-PIC-052 (13-PIC-706) and 13-PAHH-233 (13-PAHH-845).

2.12.3 Primary Combustion Chamber Exhaust Gas Temperature and Burner Controls

During normal operation, modulating the natural gas flow rate to the PCC burner provides control of the PCC exhaust gas temperature. Temperature controller 13-TIC-043 (13-TIC-752) controls the PCC burner gas rate by modulating control valve 13-FV-120 (13-FV-749) to maintain PCC exhaust gas temperature. The burner has a 10-to-1 turndown ratio. A low-low PCC exhaust gas temperature switch 13-TSLL-610 (13-TSLL-710) actuates alarm 13-TALL-610 (13-TALL-710) and an AWFCO if the PCC exhaust temperature falls below the low temperature setpoint. High PCC crossover refractory temperature is sensed by 13-TIT-610 (13-TIT-710) and will actuate an alarm and an AWFCO if the temperature rises above the high temperature setpoint. A continuous record of all the temperatures discussed above is maintained by PDARS.

2.12.4 Secondary Combustion Chamber Exhaust Gas Temperature and Burner Control

The SCC temperature will be maintained by measuring the SCC exhaust gas temperature in the crossover duct. The SCC exhaust gas temperature controller 13-TIC-103 (13-TIC-781) modulate the process water valve and/or fuel gas valve depending on whether SDS or process water is being used as a quenching medium in the SCC. Low-low temperature switch 13-TSLL-129 (13-TSLL-782) and high-high temperature alarm 13-TAHH-129 (13-TAHH-782) actuate alarms and AWFCOs if the SCC exhaust gas temperature falls below the minimum temperature setpoint or rises above the maximum temperature setpoint.

Temperature control in the LIC SCC is accomplished in two ways. When not processing Decon, the chamber temperature is maintained by modulating the burner firing rate and the amount of water cooling in the chamber. The burner firing rate is modulated down to the low-fire limit and the water spray is modulated open to quench the high-temperature exhaust gas from the primary chamber. When the SCC is processing Decon, the burner firing rate is modulated to maintain the temperature setpoint, and the Decon feed rate is held constant.

2.12.5 Secondary Combustion Chamber Decon Waste Feed Control

The flow of Decon to the SCC is monitored constantly by means of flow meter 13-FE-102 (13-FE-763) on the common Decon/water spray line. After signal processing by 13-FIC-102 (13-FIC-763), the Decon feed rate is transmitted to PDARS to maintain a continuous record. Flow-indicating controller 13-FIC-102 (13-FIC-763) also controls flow valve 13-FV-102 (13-FV-763) to the SCC spray nozzle. A high-high flow rate alarm 13-FAHH-102 (13-FAHH-763) will actuate an AWFCO if the feed rate exceeds the setpoint on a HRA basis.

2.12.6 Slag Reservoir Shell Temperature

The SRS shell temperatures are monitored by thermocouple alarms 13-TAHH-374, -375, -376, and -377 (13-TAHH-574, -575, -576, and -577). Shell temperatures are monitored to prevent overheating of the slag reservoir shell with an incumbent loss of structural integrity. The LIC waste feed will stop automatically if the exterior shell temperature rises above 500 °F.

2.12.7 Quench Outlet Gas Temperature

The quench outlet gas temperature is measured by means of thermocouple 24-TE-397 (24-TE-813). The temperature is fed through temperature indicator 24-TI-397 (24-TI-816) to PDARS for continuous process monitoring. If a high temperature in the quench outlet gas is detected, pre-alarm 24-TAH-397 (24-TAH-816) will be activated. If a high-high quench exit temperature is detected, the control system will trigger an RCRA AWFCO and cause emergency quench spray valve 24-TV-89 (24-TV-800) to open. If temperature increases to the high-high-high value, the LIC PCC and SCC burners automatically shut down.

2.12.8 Quench Brine Flow

The Brine flow to the quench tower sprays is measured by means of magnetic flow meter 24-FE-84 (24-FE-827). Acting on input from the flow meter, flow indicating controller 24-FIC-84 (24-FIC-827) modulates control valve 24-FV-84 (24-FV-827) to ensure proper flow to the quench tower, and provides input to PDARS for data recording. Low-flow alarm 24-FAL-84 (24-FAL-827) provides a warning in the control room if quench Brine flow falls below 60 gpm.

2.12.9 Venturi Scrubber Brine Flow

Brine is sprayed radially and tangentially into the venturi scrubber. The Brine flow rate is measured by the magnetic flow meter 24-FE-88 (24-FE-828). Flow indicating controller 24-FIC-88 (24-FIC-828) uses data from the Brine flow meter to modulate control valve 24-FV-88 (24-FV-828) to ensure proper Brine flow to the quench tower. Brine flow data is provided to PDARS for continuous process monitoring. Low-flow alarm 24-FAL-88 (24-FAL-828) actuates an RCRA/MACT AWFCO if flow falls below the setpoint on a HRA basis.

2.12.10 Brine pH

The Brine pH is monitored by means of alternating pH analyzers 24-AE-091A and 091B (24-AE-831A and 831B). Indicating controller 24-AIC-091 (24-AIC-831) modulates control valve 24-AV-91 (24-FV-831) to adjust the addition of caustic to maintain the desired pH and provides input to PDARS for continuous process monitoring. Low-low pH alarm 24-AALL-91 (24-AALL-831) actuates a RCRA/MACT AWFCO if the pH falls below the setpoint on a HRA basis.

2.12.11 Brine Density

Brine density is monitored by means of density meter 24-DE-083 (24-DE-835). Indicating controller 24-DIC-083 (24-DIC-835) modulates control valve 24-DV-83 (24-DV-835) to transfer Brine to the Brine holding tanks while 24-LV-115 (24-LV-818) opens to introduce process water to the system, thereby reducing overall Brine density. The same controller also provides input to PDARS for continuous process monitoring. High-high density alarm 24-DAHH-83 (24-DAHH-835) actuates a RCRA/MACT AWFCO if the Brine specific gravity rises above the setpoint on a 12-hour rolling average basis.

2.12.12 Venturi Scrubber Differential Pressure

Pressure indicator 24-PDIT-090 (24-PDIT-814) measures the differential pressure across the venturi scrubber. Indicating controller 24-PDIC-090 (24-PDIC-814) provides input to PDARS for process monitoring. The same PDIC provides high and low differential pressure alarms 24-PDAH-090 and 24-PDAL-090 (24-PDAH-814 and 24-PDAL-814), respectively. A RCRA/MACT AWFCO is initiated if the differential pressure falls below the setpoint on a HRA basis.

2.12.13 Scrubber Tower Sump Level Control

The scrubber tower sump level is measured by level indicating transmitter 24-LIT-115 (24-LIT-818). Indicating controller 24-LIC-115 (24-LIC-818) provides input to PDARS for continuous level monitoring. The same indicating controller provides high- and low-level alarms 24-LAH-115 and 24-LAL-115 (24-LAH-818 and 24-LAL-818), respectively. It also controls the level in the scrubber tower sump by modulating valve 24-LV-115 (24-LV-818) to adjust the quantity of

process water added to the quench tower sprays. If a low-low level is detected, low-low level alarm 24-LALL-099 (24-LALL-820) will be activated. If a high-high level is detected, alarm LAHH-114 (24-LAHH-819) will be activated. If either the low and low-low level alarms or the high and high-high level alarms are simultaneously activated, the furnace PCC and SCC burners will automatically shutdown. Additionally, if LAHH-114 (24-LAHH-819) is activated, all liquid inputs (other than Brine spray) to the scrubber sump are isolated.

2.12.14 Clean Liquor Flow Control

Clean liquor is pumped to the top of the packed bed scrubber and distributed evenly over the pall rings by distribution trays. The flow rate is measured by magnetic flow meter 24-FE-112 (24-FE-825). Flow indicating controller 24-FIC-112 (24-FIC-825) uses data from flow meter 24-FE-112 (24-FE-825) to modulate control valve 24-FV-112 (24-FV-825) to ensure proper circulation of liquor from the chimney tray to the top of the packed bed. The flow indicator 24-FIC-112 (24-FIC-825) provides input to PDARS for continuous process monitoring. Low-low flow alarm 24-FALL-112 (24-FALL-825) actuates a RCRA/MACT AWFCO if the flow falls below the setpoint on a HRA basis.

2.12.15 Clean Liquor Level Control

The scrubber tower chimney tray level is measured by level indicating transmitter 24-LIT-113 (24-LIT-824). Level indicating controller 24-LIC-113 (24-LIC-824) provides input to PDARS for continuous level monitoring. The same level indicating controller provides low-level alarm 24-LAL-113 (24-LAL-824). It also controls the level in the chimney tray at >55 inWC by modulating valve 24-LV-113 (24-LV-824) to adjust the quantity of process water added to the clean liquor discharge. If a low level is detected, low level alarm 24-LAL-113 (24-LAL-824) will be activated.

2.12.16 Clean Liquor pH Control

Clean liquor pH is monitored by means of alternating pH analyzers 24-AE-116A and 116B (24-AE-832A and 832B). Indicating controller 24-AIC-116 (24-AIC-832) modulates control valve 24-AV-116 (24-FV-832) to adjust the addition of caustic to maintain the desired pH, and provides input to PDARS for continuous process monitoring. The alarms 24-AAD-116, 24-AAH-116, 24-AAL-116, and 24-AALL-116 (24-AAD-832, 24-AAH-832, 24-AAL-832, and 24-AALL-832) actuate RCRA/MACT AWFCO if the pH falls below the setpoint on a HRA basis.

2.12.17 Clean Liquor Density Control

Clean liquor density is monitored by means of density meter 24-DE-117 (24-AE-826). If indicating controller 24-DIC-117 (24-DIC-826) senses density in excess of desired values, it overrides level controller 24-LIC-113 (24-LIC-824) to open control valve 24-LV-113 (24-LV-824) to increase the flow of process water to the packed beds, thereby reducing overall clean liquor density. This causes the level to increase until the liquor overflows into the scrubber reservoir. The same controller also provides density data to PDARS for recording. High density alarms 24-DAH-117 (24-DAH-826) and 24-DAHH-117 (24-DAHH-826) actuate a MACT AWFCO if the clean liquor specific gravity exceeds the setpoint.

2.12.18 Demister Level Control

The exhaust gas exits the scrubber tower and flows into the demister to remove any remaining water droplets and PM. Liquids and entrained particles drain to the vessel sump. Over time, the sump level increases and must be drained from the vessel. The liquid level is monitored by level indicating transmitter 24-LIT-143 (24-LIT-864) and controlled by level indicating controller 24-LIC-143 (24-LIC-864). The 24-LIC-143 (24-LIC-864) also provides continuous level input to PDARS. When the liquid level reaches 14 inches, LIC demister water return pump PAS-PUMP-136 (PAS-PUMP-222) is energized and 24-LIC-143 (24-LIC-864) modulates control valve 24-LV-143 (24-LV-864) to lower the level to 10 inches by directing flow to the scrubber tower sump. To avoid constant cycling of PAS-PUMP-136 (PAS-PUMP-222), liquid is continuously circulated to the demister through pressure control valve 24-PCV-148 (24-PCV-868) when it is not pumping liquid to the scrubber tower sump. High-high-high and low-level alarms are also provided from 24-LIC-143 (24-LIC-864). Low-low level switch 24-LSLL-144 (24-LSLL-865) provides an alarm and causes shutdown of PAS-PUMP-136 (PAS-PUMP-222) and LIC demister empty out pump PAS-PUMP-121 (PAS-PUMP-221) to protect against operating the pumps with an empty sump. Similarly, high-high level switch 24-LSHH-146 (24-LSHH-866) alerts the operator to take action before the candles are flooded. Equivalent instrumentation and control valves are provided for the spare demister.

2.12.19 Demister Candle Pressure Drop

Particulate matter carried by the exhaust gas into the demister may become embedded in the candle filter elements. Over time these particles increase the pressure drop across the candles and limit their effectiveness. Eventually cleaning or replacement of the candle filter elements is required. Differential pressure indicating transmitter 24-PDIT-147 (24-PDIT-867) senses the pressure drop, while 24-PDI-147 (24-PDI-867) provides continuous pressure drop input to PDARS and provides alarms when the pressure drop increases to unacceptable values. High differential pressure alarm 24-PDAH-147 (24-PDAH-867) alerts the operator that the filter elements require cleaning. Should no action be taken, high-high differential pressure alarm 24-PDAHH-147 (24-PDAHH-867) stops feed to the furnace. Equivalent instrumentation is provided for the spare demister.

2.12.20 Liquid Incinerator Bleed Air Valve Operation

The LIC exhaust blowers require a minimum flow at all times to cool the fan wheels and prevent thermal distortion. During startup and periods of extended idle, turndown conditions are extreme and necessitate augmenting exhaust gas flow with outside air to provide minimum blower flow. This is accomplished by using manual controller 24-HIC-750 (24-HIC-753) to open 24-HV-750 (24-HV-753) and introduce outside air. 24-HV-750 (24-HV-753) must be completely closed before agent feed can begin. The air intake to 24-HV-750 (24-HV-753) must be capped before agent feed may begin to ensure no path exists for agent migration to the atmosphere and to prevent inadvertent dilution of emissions being monitored.

2.12.21 Liquid Incinerator Exhaust Gas Oxygen Concentration

The LIC exhaust gas O₂ concentrations are measured continuously by O₂ analyzers 13-AIT-229 and 24-AIT-210 (13-AIT-798 and 24-AIT-717). Oxygen concentrations are also displayed and provided continuously to PDARS by 13-AIT-229 and 24-AIT-210 (13-AIT-798 and 24-AIT-717). If the O₂ concentration is below the preset low-low level setpoint, alarms 13-AAL-229 and 24-AAL-210 (13-AAL-798 and 24-AAL-717) are activated and a RCRA AWFCO is initiated. If the O₂ concentrations are above the high-high level setpoint, alarms 13-AAH-229 and 24-AAH-210 (13-AAH-798 and 24-AAH-717) are activated and a RCRA AWFCO is initiated.

2.12.22 Liquid Incinerator Exhaust Gas Carbon Monoxide Concentration

The LIC exhaust gas CO concentrations are measured continuously by CO analyzers 13-AIT-083 and 24-AIT-078 (13-AIT-798 and 24-AIT-717). These analyzers display results locally and provide continuous CO data to PLCs. The PLCs calculate a one-minute average. The PLC also calculates a HRA corrected to 7% O₂ dry volume, which is compared to the RCRA limit of 100 ppm_{dv}. If the CO concentrations are above the limit, the alarms 13-AAH-083 or 24-AAH-078 (13-AAH-798 or 24-AAH-716) are activated and a RCRA/MACT AWFCO is initiated. The averages are stored by PDARS.

2.12.23 Liquid Incinerator Exhaust Gas Mustard Concentration

The LIC exhaust gases in the LIC duct are continuously monitored for mustard by ACAMS PAS 704 (PAS 705) and the LIC duct DAAMS. Normal operation uses one ACAMS in the LIC duct with an additional ACAMS as a backup. Three ACAMS will be used to monitor mustard exhaust gas concentrations in the LIC duct during this ATB. Mustard is monitored at the common stack by ACAMS PAS 707a, 707b, and 707c. For both locations, two ACAMS are on-line to ensure continuous monitoring of agent while the third ACAMS is in the standby mode. One ACAMS will be sampling while the second ACAMS is in the purge/analysis mode. If the ACAMS detect mustard concentrations that are greater than the setpoint in Appendix D, an

AWFCO is initiated and audio and visual alarms are activated. The DAAMS tubes will be changed hourly during the LIC Mustard ATB, and CAL personnel will analyze the collected DAAMS tubes.

2.12.24 Liquid Incinerator Exhaust Gas Flow Rate

Exhaust gas flow rates for the LIC are measured with a V-Cone® flow meter 24-FIT-9431 (24-FIT-9902). The flow meter is installed in the exhaust duct located after the scrubber tower and before the demister to measure the volumetric flow rate. The V-Cone® is positioned in the center of the pipe to increase the velocity of the exhaust flow, which creates a differential pressure. The pressure difference is measured and converted to a scfm flow rate. The LIC control system records the value and generates a HRA. If the HRA setpoint is exceeded, a RCRA/MACT AWFCO is initiated and audio and visual alarms are activated.

2.13 INCINERATION SYSTEM STARTUP PROCEDURES

This section discusses the start-up procedures as required by 40 CFR 270.62(b)(2)(vii). The LIC is brought to full operating condition while firing natural gas before any hazardous wastes are introduced into the PCC or SCC. Full operating condition means that combustion temperatures are above the minimum for feeding waste, the LIC PAS is operational, the LIC is under vacuum, and the unit is in compliance with all regulatory limits. The start-up sequence is performed in reverse order of the direction that waste feed and combustion products pass through the system: i.e., the PAS is started first, and the waste feed systems started last. Before any of the LIC processing equipment can be started, all utilities and control systems must be operational. The typical time required for startup from a cold system is about 36 hours. A test of the AWFCO system will be performed before agent is fed to the system, and the DAQ and DSHW will be notified 7 days in advance of the test.

A summary of the LIC start-up procedures is presented below.

2.13.1 Startup of Utilities

The successful startup of the utility systems includes the following steps:

1. Provide electrical power to the main switchgear, the motor control centers, and the control room.
2. Place the Uninterruptible Power Supply (UPS) in operating mode.
3. Place the emergency power generator in stand-by mode.
4. Start all PLCs associated with LIC operation.
5. Start the plant and instrument air systems.
6. Start the fuel gas system.
7. Start the process water system.

8. Start the caustic system.
9. Start the ACS and SDS
10. Ensure that at least one Brine surge tank has sufficient freeboard for sustained operations.
11. Perform a pre-operational check of all systems that are to be used.

2.13.2 Startup of the Liquid Incinerator Pollution Abatement System

The sequential steps for successful startup of the LIC PAS are outlined below:

1. Perform the following steps, as applicable:
 - a. Check that the quench tower sump is empty. Check that any debris left from earlier operations is removed. Check that all manways are securely in place.
 - b. Check that the caustic valve is lined up to provide Brine and clean liquor pH control.
 - c. Confirm that Brine and clean liquor densities are at acceptable values. If not, add process water to the system, and drain to a Brine surge tank as necessary to achieve an acceptable density.
 - d. Confirm that the scrubber tower sump level is within acceptable limits.
 - e. Remove the bleed air damper cover.
 - f. Check that the exhaust blower lube oil system is operating and that the oil temperature is acceptable.
 - g. Verify that the ACAMS and DAAMS are on line.
 - h. Verify that agent concentration in the furnace room is less than the setpoint.
 - i. Verify from 13-AISH-035 (13-AISH-850) that there are no fuel gas leaks in the LIC Primary Room.
 - j. Verify from 13-AISH-235 (13-AISH-353) that there are no fuel gas leaks in the LIC Secondary Room.
2. To start the PAS:
 - a. Confirm that the demister water return pump is lined up to the scrubber tower sump and that the demister sump level is controlling to setpoint.
 - b. Start the Brine and clean liquor pumps. Adjust flow rates, as necessary, and confirm the availability of the spare pumps.
 - c. Start the exhaust blower.

2.13.3 Startup of the Secondary Combustion Chamber

The sequential steps for successful startup of the SCC are outlined below:

1. Start the combustion air blower, and confirm proper combustion airflow.
2. Check that the slag removal system is lined up and available, and that its electric heaters are in AUTO.
3. Signal the burner management system to light the SCC burner. Monitor the burner air purge, the lighting of the pilot, and the lighting of the burner.
4. Place the burner in AUTO, and signal the SCC PLC to increase the burner gas flow to raise the SCC temperature according to the refractory heat-up program.
5. When the SCC temperature reaches 1,500 °F, cut in process water to the SCC spray nozzle.
6. Monitor the PLC while it brings the SCC up to operating temperature.
7. Verify that the bleed air damper is closed and its cover installed.
8. When the PCC and SCC reach permitted minimum operating temperatures (refer to Appendix D), and all Limiting Conditions of Operation (LCOs) and waste feed parameters are satisfied, the LIC is ready to receive hazardous waste.
9. Ensure that the selected SDS tank has been sampled and its analysis shows all chemical constituents within acceptable limits.
10. Switch SCC spray from process water to Decon, and adjust its rate to the desired setpoint while maintaining PCC and SCC temperatures and other system operating parameters within permit limits.

2.13.4 Startup of the Liquid Incinerator Primary Combustion Chamber

The sequential steps for successful startup of the LIC PCC are outlined below:

1. Ensure that the fuel oil purge to the PCC burner is disconnected.
2. Start the PCC combustion air fan, and confirm proper combustion airflow.
3. With SCC gas temperature between 1,550 °F and 2,050 °F, reinstall the PCC burner gun.
4. Verify that the bleed air damper is closed and its cover is installed.
5. Signal the burner management system to light the PCC burner. Monitor the burner air purge, the lighting of the pilot, and the lighting of the burner.
6. Place the burner in AUTO and signal the PCC PLC to increase the burner gasflow to raise the PCC temperature according to the refractory heat-up program.
7. Monitor the PLC as it brings the PCC up to operating temperature.
8. When the PCC and SCC reach permitted minimum operating temperatures (refer to Appendix D), and all LCOs and waste feed parameters are satisfied, the LIC is ready to receive hazardous waste.
9. Start agent feed and adjust to the desired setpoint, while maintaining PCC and SCC temperatures and other system operating parameters within permit limits.

3.0 SAMPLING AND ANALYSIS PROCEDURES

The sampling and analysis objectives for the TOCDF LIC Mustard ATB are to:

- Demonstrate maximum agent feed rate while maintaining a mustard DRE $\geq 99.9999\%$ for the RCRA permit.
- Demonstrate maximum surrogate HAP feed rate to the SCC while maintaining a chlorobenzene DRE $\geq 99.99\%$.
- Demonstrate control of CO emissions by maintaining the CO concentration at <100 ppm, @ 7% O₂, on a HRA basis and < 1.52 lb/hr (Title V Permit).
- Demonstrate control of PM emissions by showing that the concentration is:
 - < 29.7 mg/dscm @ 7 % O₂ (MACT Limits).
 - < 1.0 lb/hr (Title V permit);
- Provide data regarding the emissions of metals, PCDDs/PCDFs, and other PICs for use in updating the HHRA and demonstrating compliance with the MACT limits.
- Demonstrate that the PCDD/PCDF emissions are less than 0.40 ng 2,3,7,8-TCDD TEQ/dscm @ 7% O₂.
- Demonstrate that the emission rate of SO₂ is below the Title V limit of 9.5 lb/hr.
- Demonstrate control of NO_x emissions on a HRA basis.
- Demonstrate that the emissions of THC are less than 10 ppm_{dv} @ 7% O₂ on a HRA (monitored continuously with a CEMS) and reported as propane.
- Demonstrate that the halogen emissions (HF, HCl, and Cl₂) are < 32 ppm_{dv} @ 7% O₂ expressed as HCl equivalents.

The sampling and analysis procedures included in this section were selected to accomplish the objectives discussed above. Detailed information on the sampling and analysis methods are provided in the QAPP (Appendix A), and reference to the QAPP will be made to prevent duplication of text. The rationale for the selection of the POHC is presented in Section 5.2. The PIC emissions data, including PCDDs and PCDFs, are being collected for use in updating the DCD HHRA.

3.1 SAMPLING LOCATIONS

Samples collected for the LIC Mustard ATB will be divided into exhaust gas samples, process stream samples, and neat mustard samples. Exhaust samples will be collected in the LIC duct using seven sampling trains. Process samples will include Brine, Decon, NaOH makeup, process water, and slag. Samples of the spiking solution will be collected from the liquid delivery system. Neat mustard samples will be collected from the ACS tanks.

3.1.1 Exhaust Gas Sampling Locations

The DFS, MPF, LIC1, and LIC2 share a common stack. This arrangement requires that the samples used to verify the performance of each furnace system be collected in the duct between the ID fan and the common stack. The parameters to be measured at this location include mustard, CO, O₂, VOCs, SVOCs, metals emissions, PM, THC, PCDDs/PCDFs, SO₂, NO_x, Cl₂, HF, and HCl. Tables 3-1 and 3-2 lists the exhaust gas sampling ports used for the sampling methods for LIC1 and LIC2, respectively.

Mustard is monitored at two different locations for two different purposes. The DAAMS located in each LIC duct will be used to collect the agent data for the DRE calculations. The ACAMS in each LIC duct will be used as stop feeds. The station number for the agent monitors are PAS 704 and 705 for LIC1 and LIC2, respectively (see Appendix D). During this ATB, there will be three ACAMS and two DAAMS stations at the LIC duct sample location in order to sample the exhaust gas stream continuously. One ACAMS will be in the sample mode while the second ACAMS is in the analysis mode. The third ACAMS is held in reserve to replace an ACAMS if it fails.

The ACAMS and DAAMS are also found in the common stack monitoring house. This ACAMS/DAAMS sample location is designated as station PAS 707 for mustard (see Appendix D). This location is used to activate the AWFCO system. The stack monitoring station monitors the combined gases leaving all furnace systems and is a final safety monitor of the exhaust gas leaving the stack. The stack monitoring house also has three ACAMS and one DAAMS for each agent. The PDARS records each station.

Additional samples to be collected in the duct include seven trains for sampling emission levels of different parameters. For LIC1 and LIC2, Tables 3-1 and 3-2, respectively, list the sampling ports associated with each analysis parameter. The arrangement of the LIC1 and LIC2 sampling ports are presented in Figures 3-1 and 3-2.

TABLE 3-1. LIQUID INCINERATOR 1 EXHAUST GAS SAMPLING SUMMARY

SAMPLING TRAIN	ANALYSES PERFORMED	LOCATION	PURPOSE
Method 1	Traverse Points	Each Port	Report Information
Method 2	Exhaust Gas Velocity	Isokinetic Trains	Report Information
Each Isokinetic Train	Exhaust Gas Moisture	Isokinetic Trains	Report Information
Method 0010	SVOCs	Ports TBS-013 & TBS-014	Report Information
Method 0010-TOC	SVTOC & NVTOC	Ports TBS-016 & TBS-017	Report Information
Method 0023A	PCDDs & PCDFs	Ports TBS-013 & TBS-014	Report Information
Method 0031	VOCs	Port TBS-018	Report Information
Method 0040	VTOC	Port TBS-015	Report Information
Method 5/0050	PM, HF, HCl & Cl ₂	Ports TBS-011 & TBS-012	Report Information
Method 29	HHRA Metals	Ports TBS-011 & TBS-012	Report Information
ACAMS	Mustard	Common Stack	AWFCO and Report Information
DAAMS	Mustard	Common Stack	Agent Confirmation & Report Information
ACAMS	Mustard	LIC1 Duct ACAMS Port	Stop Feed & Report Information
DAAMS	Mustard	LIC1 Duct DAAMS Port	Report Information (POHC DRE)
CEMS	O ₂ , CO	LIC1 Duct CEMS Port	AWFCOs & Report Information
CEMS	CO ₂ , THC, SO ₂ , NO _x	LIC1 Duct Port	Report Information

TABLE 3-2. LIQUID INCINERATOR 2 EXHAUST GAS SAMPLING SUMMARY

SAMPLING TRAIN	ANALYSES PERFORMED	LOCATION	PURPOSE
Method 1	Traverse Points	Each Port	Report Information
Method 2	Exhaust Gas Velocity	Isokinetic Trains	Report Information
Each Isokinetic Train	Exhaust Gas Moisture	Isokinetic Trains	Report Information
Method 0010	SVOCs	Ports TBS-009 and TBS-010	Report Information
Method 0010-TOC	SVTOC & NVTOC	Ports TBS-007 and TBS-008	Report Information
Method 0023A	PCDDs & PCDFs	Ports TBS-009 and TBS-010	Report Information
Method 0031	VOCs	Port TBS-006	Report Information
Method 0040	VTOC	Port LC	Report Information
Method 5/0050	PM, HCl & Cl ₂	Ports LA and LB	Report Information
Method 29	HHRA Metals	Ports LA and LB	Report Information
ACAMS	Mustard	Common Stack	AWFCO and Report Information
DAAMS	Mustard	Common Stack	Agent Confirmation and Report Information
ACAMS	Mustard	LIC2 Duct ACAMS Port	Stop Feed and Report Information
DAAMS	Mustard	LIC2 Duct DAAMS Port	Report Information (POHC DRE)
CEMS	O ₂ , CO	LIC2 Duct CEMS Port	AWFCOs and Report Information
CEMS	CO ₂ , THC, SO ₂ , NO _x	LIC2 Duct Port	Report Information

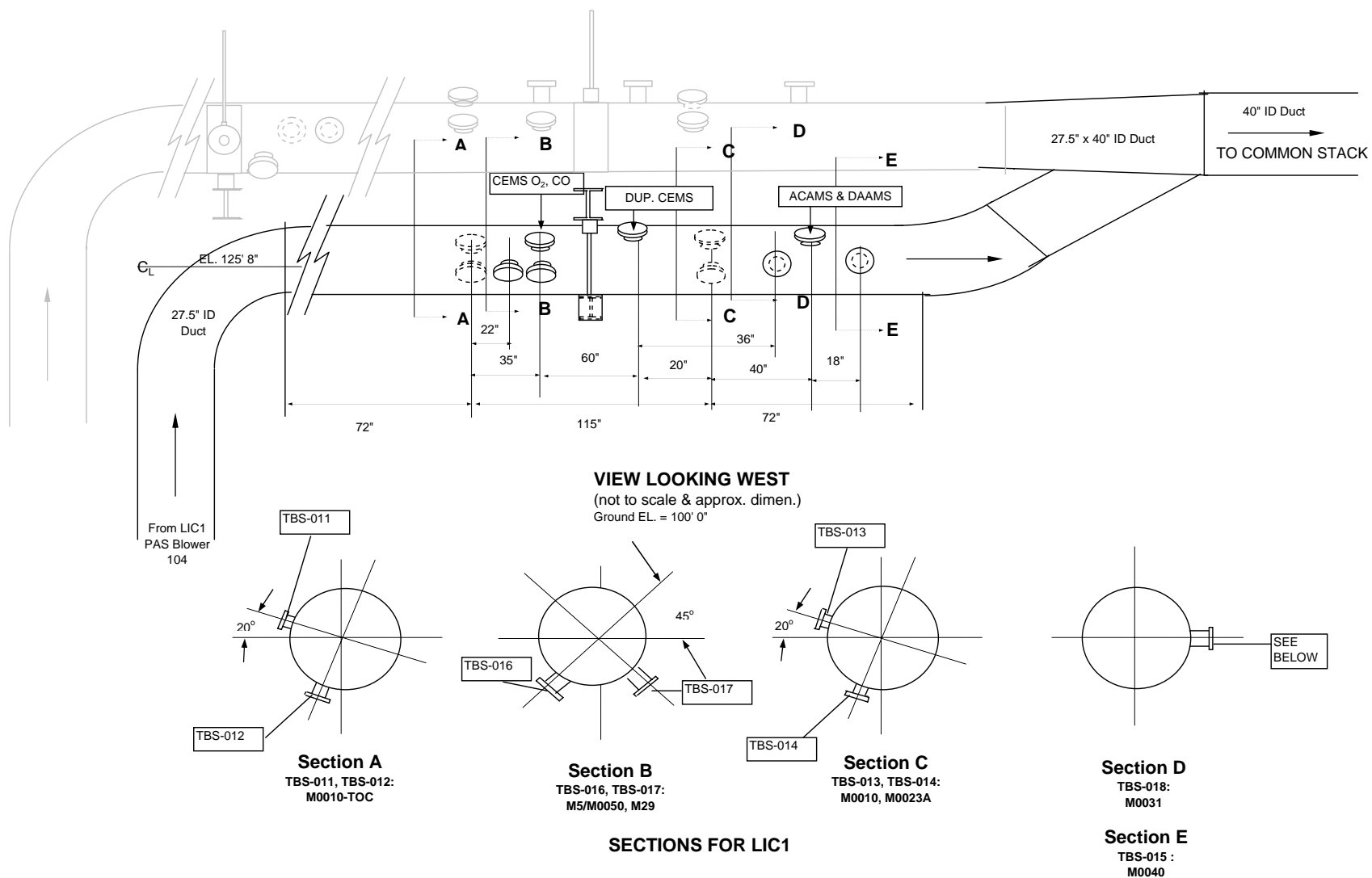


FIGURE 3-1. LIC1 DUCT SAMPLING PORT LOCATIONS

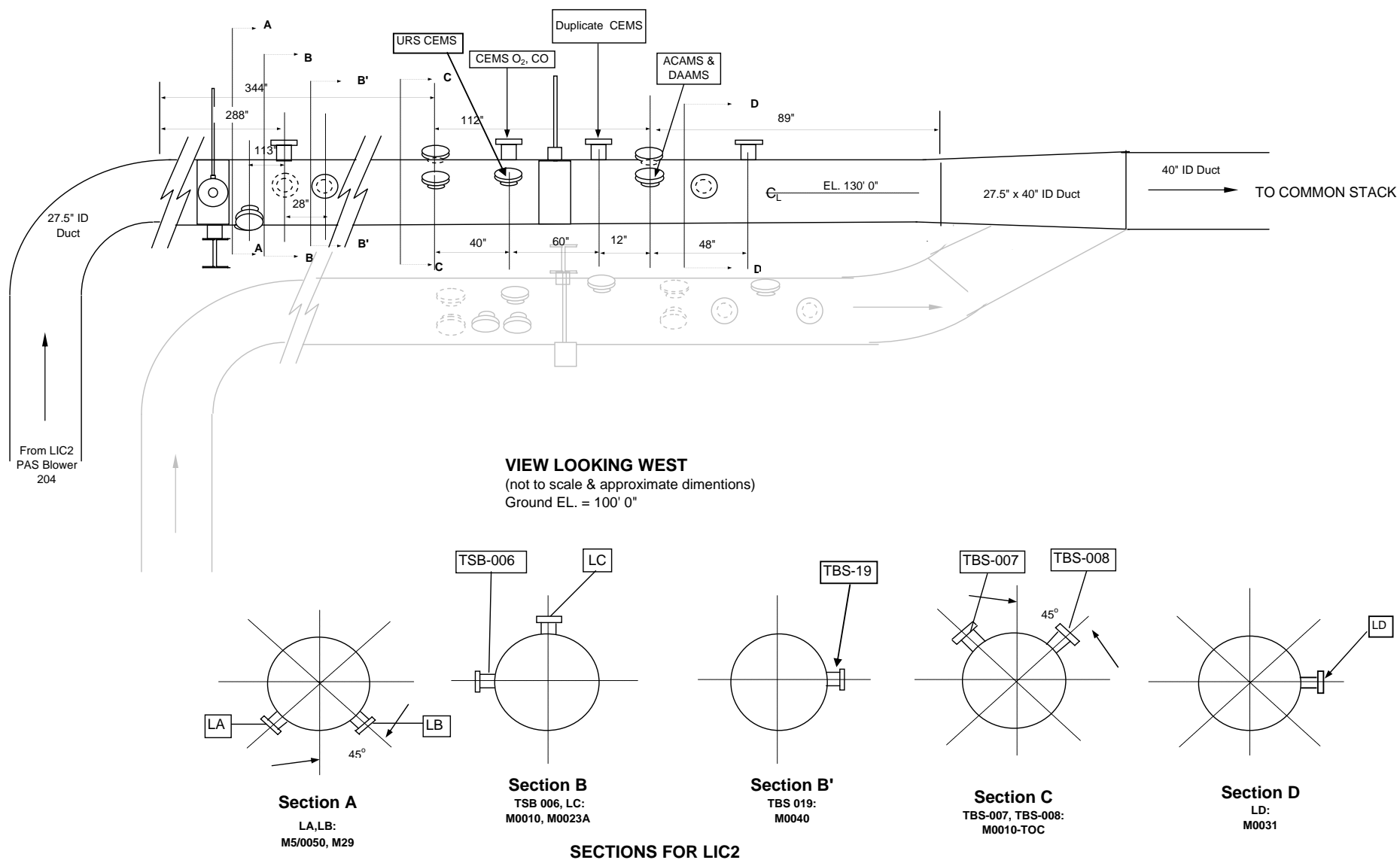


FIGURE 3-2. LIC2 DUCT SAMPLING PORT LOCATIONS

3.1.2 Process Stream Sampling Locations

Process streams sampled as part of the LIC Mustard ATB include the agent waste feed, Decon, Brine, metals spiking solution, slag, NaOH makeup, and process water. Mustard samples will be collected from a valve in the strainer housing on the agent line exiting the ACS tanks. A grab sample of Decon is taken from the SDS tanks at the Agent Sampling Room (ASR) glove box (ASR-GLBX-101). If the ASR glove box is not available, the Decon sample will be taken from a valve on the SDS tank. The Brine and NaOH samples will be taken via taps on the discharge of the pumps used to move the solutions. Samples of the metals spiking solutions will be collected from taps on the liquid delivery system. After this ATB, an attempt will be made to drain the slag. If slag is collected, slag samples will be taken from the cooled slag drums, and the analyses will be included in the ATB Report.

3.2 SAMPLING METHODS

The samples for each run will be collected between the time the test starts and the time the test is declared complete. The exception to this is the collection of a slag sample, which will be collected after testing to allow the slag to be tapped and cooled. The DAQ and DSHW representatives will be notified of times when process samples will be collected, when leak checks of sampling trains and pitot tubes will be conducted, and when sample recovery begins.

3.2.1 Process Stream Sampling Methods

Liquid process samples will be collected according to American Society for Testing and Materials (ASTM) Method D3370 (10) by attaching a sample line to the tap and flushing the sample line. The resulting flush will be managed in accordance with applicable EPA and DSHW regulations. According to this method, the sample line is inserted into the sample container, and the tap is opened so that the sample fill time exceeds one minute. This sampling flow reduces the loss of volatile compounds from the sampling container prior to closure of the container. The selected method ensures that the actual material collected is representative of the stream. Separate sub-sample bottles are used for each sample. Samples of the NaOH makeup and process water will be collected during one of the runs using this method. Samples of the spiking solutions will be collected from taps in the liquid delivery system. Brine samples will be collected during the final 60 minutes of each run. If slag can be drained from the LIC at the conclusion of this ATB, a slag sample will be collected. A composite slag sample will be collected by removing a sample of slag from each slag drum with a sample scoop using ASTM Method D5633 (11).

The ACS tank will be filled with agent before beginning a run. Circulation pumps have been added to the ACS tanks to allow agent to be removed from the tank and then returned to achieve a homogeneous mixture of agent. The tank contents will be mixed for 30 minutes before

beginning feed or collection of the agent sample. Mixing the contents of the tank before sampling makes it unnecessary to collect composite agent samples. Agent samples will be collected from the ACS tank.

3.2.2 Mustard Sampling Methods for Exhaust Gas

Normal operations of the ACAMS and DAAMS are covered in Section 2.9.2. The LIC Mustard ATB will require special operating conditions for the ACAMS and DAAMS to monitor mustard concentrations. The change to the ACAMS is that three ACAMS will be sampling the exhaust gas at the LIC duct. One ACAMS will be on standby, and the other two will be staggered so that one ACAMS is always sampling. The ACAMS staggering will be verified hourly.

There are four changes to standard DAAMS operation for the LIC Mustard ATB:

1. The tubes will collect samples for one hour.
2. Two DAAMS stations will be set up on the LIC duct. One DAAMS station will collect samples while the second station is having a new set of tubes installed and leak checked. The DAAMS tubes will collect one-hour samples, and when one set is complete, the other station will begin sampling, which will allow continuous sampling for mustard.
3. A QP will be included in each set of tubes.
4. A field blank will be analyzed with the DAAMS tube for each run, serving as a QC step to ensure the quality of the data. The field blank will be transported to the sampling location, but not put into service. The field blank will then be returned to the CAL for analysis.

3.2.3 Additional Sampling Methods for Exhaust Gas

The exhaust gas will be monitored as outlined in Tables 3-1 and 3-2 using CEMS and selected EPA methods sampling trains. The TOCDF CEMS will collect data on the O₂ and CO exhaust gas concentrations. (The TOCDF CEMS are discussed in Section 2.9.1.) The THC, SO₂, and NO_x concentrations will be monitored using a certified CEMS supplied by the sampling subcontractor. Certification and calibration data for the sampling subcontractor's CEMS will be available after the sampling subcontractor has arrived on site and set up the instrumentation. The sampling subcontractor's CEMS will also monitor CO₂ to allow calculation of the exhaust gas molecular weight.

The EPA methods for sampling the exhaust gas will be taken from SW-846 (1) and 40 CFR 60 (2). These methods are:

- A combination of Method 5 (2) and Method 0050 (1), which will use duplicate trains to collect samples for PM, Cl₂, HF, and HCl emissions.
- Method 0031 (1), which will be used to collect VOC samples.
- Method 0010 (1), which will be used to collect SVOC samples.
- Method 0023A (1), which will be used to collect samples for PCDDs/ PCDFs.

- Method 0040 (6), which will be used to collect VTOC samples.
- A separate Method 0010 sampling train (6), which will collect SVTOC and NVTOC samples.
- A Method 29 sampling train (2), which will collect samples for metals emissions.

3.3 ANALYSIS METHODS

Summaries of these analysis methods are included in this section for completeness; detailed descriptions of the analysis methods are located in the QAPP (Appendix A, Section 9).

3.3.1 Analysis Methods for Mustard

The organic compounds in the waste feed will be analyzed using a gas chromatograph/mass spectrometer (GC/MS) as directed by TE-LOP-584. Metals present in the mustard are analyzed by acid digesting the sample and then analyzing the digested sample by TE-LOP-547. Appendix A lists the specific organic compounds and metals to be analyzed as well as the methods of analysis.

3.3.2 Analysis Methods for Process Stream Samples

The process stream samples will be analyzed by the following methods:

- Method 8260B (1), which will be used to analyze samples for VOCs.
- Method 8270C (1), which will be used to determine SVOC concentrations.
- Methods 6010B and 7470A (1), which will determine metal concentrations.
- Method 6010B, which will be used to analyze the metal spiking solution samples for the metals of interest.

3.3.3 Analysis Method for Slag Samples

One sample of the slag will be collected at the end of the LIC Mustard ATB. The slag sample will be analyzed for total metals and evaluated by the Toxicity Characteristic Leaching Procedure (TCLP). The following methods will be used for analyses:

- Method 3052 (1) will be used to digest samples of the slag and Methods 6010B and 6020 (1) will be used to analyze for the HHRA metals.
- TCLP Method 1311 (1) will be used to extract the slag.
- Method 6010B (1) will be used to analyze the TCLP extract for TCLP Metals.

3.3.4 Analysis Methods for Exhaust Gas Samples

Agent concentrations in the exhaust gas will be measured using the ACAMS and DAAMS as discussed in Section 2.9.2. Samples of the exhaust gas will be collected using seven sampling trains. The collected samples will be analyzed using the following methods:

- Method 5 (2) will be used to analyze PM.
- Method 9057 (1) will be used to measure halogen concentrations.
- Method 5041A (1) will be used to measure concentrations of VOCs.
- Method 8270C (1) will be used to determine SVOCs.
- Method 0023A/8290 (1) will be used to determine concentrations of PCDDs/PCDFs.
- Gas chromatograph with a Flame Ionization Detector (GC/FID) will be used to determine the VTOC as described in the EPA Guidance (6).
- GC/FID will be used to determine the SVTOC concentration as directed by EPA Guidance (6).
- Gravimetric methods will be used to determine the NVTOC concentration as directed by EPA Guidance (6).
- Method 6020 (1) will be used to analyze metals emission samples.
- Method 6C (2) will be used to analyze for SO₂.
- Method 7E (2) will be used to analyze for NO_x.
- Method 25 (2) will be used to analyze for THC.

3.4 AUDIT SAMPLES

The DSHW may furnish audit samples during the LIC Mustard ATB. An audit cylinder containing VOCs for sampling and analysis or a spiked audit sample for analysis may be supplied. The VOC audit cylinder will be sampled at the duct sampling location. These samples will be packed, transported, and analyzed in the same manner as other samples. Results will be reported in units appropriate to the sample submitted and the analytes present. Results of the VOC Audit will be reported in parts per billion on a volume basis and included in the final report.

4.0 MUSTARD AGENT TRIAL BURN SCHEDULE

The LIC Mustard ATB is scheduled for the third quarter of 2006. The submittal of this plan will serve as the official 60 day MACT notice required for CPT plans. The DAQ and DSHW will be notified at least 30 days in advance of the actual ATB date.

4.1 PERFORMANCE RUN SCHEDULE

The trial burn will begin after TOCDF has: received approval of the LIC Mustard ATB Plan; successfully completed the plant changeover for mustard processing; and successfully completed shakedown of the incinerator that will burn the mustard. The LIC Mustard ATB should span about 5 days: 1 day for setup, 3 days of testing, and 1 day for cleanup. However, the LIC must achieve steady-state conditions by 2:00 PM on any test day or the run will be cancelled for that day. The typical test run schedule for the trial burn is shown in Figure 4-1.

4.2 DURATION OF THE LIQUID INCINERATOR MUSTARD AGENT TRIAL BURN

The LIC Mustard ATB will consist of one test condition with three replicate sampling runs. One run per day is planned. Actual sampling time during each sampling run will last about 6 hours. The LIC will be fed the spiking solution and mustard at least 15 minutes before each sampling run to establish steady operation at process test conditions. This, combined with sample train changeovers, will cause total test time each day to be at least 8 hours. Assuming minimal interruption of LIC operation during this ATB, the incinerator is expected to operate for 8 or more hours per day for 3 days.

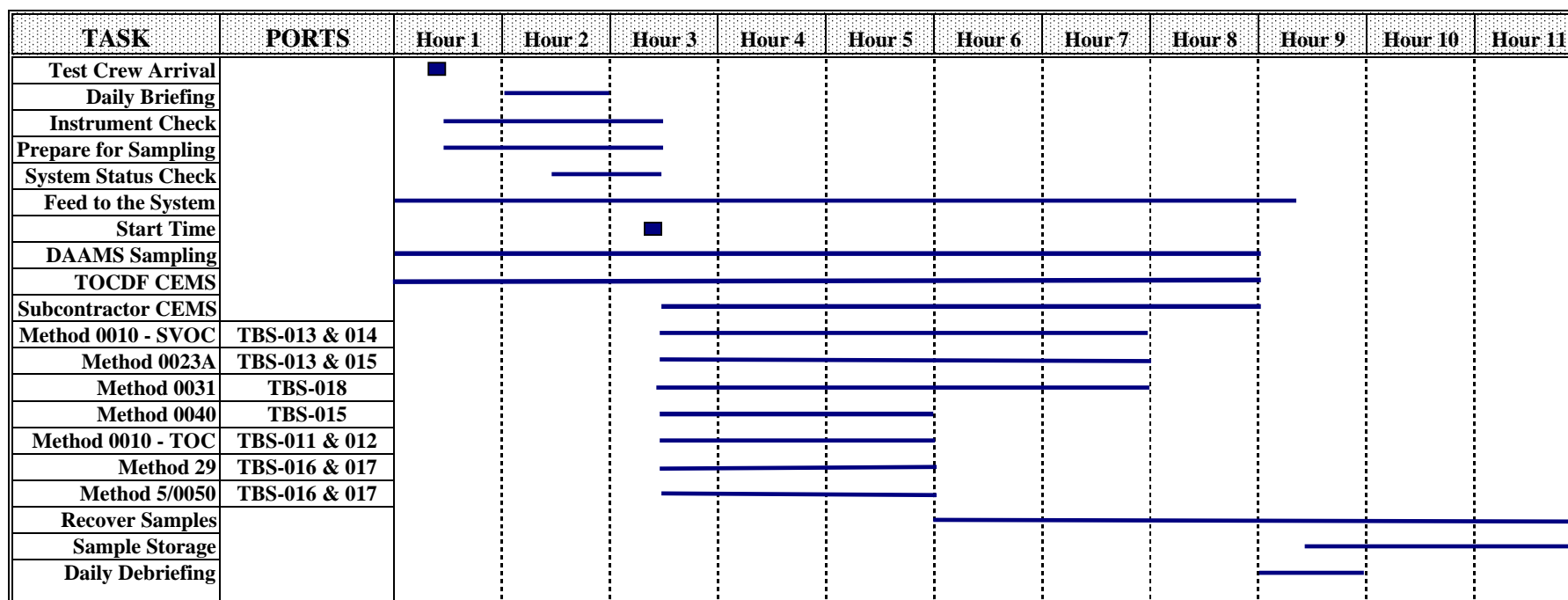


FIGURE 4-1. EXAMPLE DAILY SAMPLING SCHEDULE FOR THE LIC MUSTARD ATB

5.0 MUSTARD AGENT TRIAL BURN PROTOCOLS

The LIC Mustard ATB will consist of three replicate runs performed at one set of operating conditions. Results from the mustard ATB run in one furnace will serve as a verification of system performance for both LICs. The mustard used for this ATB will be spiked with metals to account for variations in the metals concentrations in the agent that may exist between different lots and munitions. The following subsections will discuss the waste to be burned, the selection of the POHC, the test operating conditions, waste feed rates, and total waste to be processed.

5.1 WASTE CHARACTERIZATION

Two waste streams will be treated during the LIC Mustard ATB: Liquid mustard and Decon. Three spiking solutions will also be processed in the LIC as part of the ATB. The State of Utah has defined mustard as acutely hazardous and identified it as a P999 waste. The same identification is applied to any waste that has been contaminated by mustard. TOCDF does not produce or handle any liquids containing PCBs that would be regulated under TSCA and does not treat any waste materials with dioxin waste codes (F020, F021, F022, F023, F026, or F027).

5.1.1 Mustard Agent Waste Feed

The liquid waste stream fed to the LIC PCC will be a mixture of organic compounds with high heating values that have been drained from munitions and bulk containers. This waste stream is composed of mustard, impurities present from the manufacture of mustard, stabilizing agents, and the decomposition products of these compounds. A representative sample of the agent used during this ATB will be collected for each run. The samples will be analyzed for organic compounds and metal concentrations. Table 5-1 lists the chemical, physical and thermodynamic properties of mustard. Data on the composition of the mustard is limited to information presented in Appendix E. The expected ranges of concentrations for mustard and the major impurities are shown in Table 1-1. This data is for mustard from ton containers; agent from other munitions may have additional metals present. Metals will be spiked into the PCC to accommodate the possibility of higher metal concentrations than those presented in Table 1-1. The mustard processed in the LIC Mustard ATB will be about 89 weight percent (Wt%) *bis*(2-chloroethyl) sulfide, 3.2 Wt% 1,2-*bis*(2-chloroethylthio)ethane (Q), 1.4 Wt% 1,4-dithiane, 0.6 Wt% 1,2-dichloroethane, and 0.2 Wt% T. The DRE calculations will be based on the purity analysis of the agent processed during the LIC Mustard ATB.

TABLE 5-1. MUSTARD AGENT PROPERTIES

PROPERTY	HD	HT
Chemical Name	<i>bis</i> (2-chloroethyl) sulfide	60:40 H:T T = <i>bis</i> [2-(2-chloroethylthio)ethyl] ether
Chemical Formula	H = C ₄ H ₈ Cl ₂ S	T = C ₈ H ₁₆ Cl ₂ OS ₂
Molecular Weight (g/mole)	159.08	T = 263.25; 60:40 = 200.75
Weight Percent Chlorine	44.57 %	T = 26.93 %; 60:40 = 37.51 %
Vapor Specific Gravity	5.4	6.92
Liquid Density @ 77 °F (lb/ft³)	79.29	79.29
Freezing Point (°F)	57	34
Boiling Point (°F)	442	442
Flash Point (°F)	221	212
Vapor Pressure @ 68 °F (mmHg)	0.072	0.104
Viscosity @ 77 °F (centistokes)	3.95	6.05
Color	Amber to Dark Brown	Amber to Dark Brown
Odor	Garlic	Garlic
Solubility	Completely soluble in acetone, CCl ₄ , tetrachloroethane, ethyl benzoate, and all ethers	Completely soluble in acetone, CCl ₄ , tetrachloroethane, ethyl benzoate, and all ethers
Higher Heating Value (Btu/lb)	8,500	9,400
Physical State	Viscous Liquid	Viscous Liquid

5.1.2 Metals Spiking Feed

Concentrations of metals in the spiking solution were chosen to establish a “worst-case” condition for metal emissions from the LICs. Table 1-1 shows that metal concentrations in the mustard are low. Experience with other agents has shown that metal concentrations can vary from lot to lot and from one munition to another. Therefore, the selected metals spikes were taken from the LIC VX ATB to cover the expected range of metals from different munitions.

Table 5-2 lists the proposed metals to be spiked, their feed rate and the estimated metals concentrations in the exhaust gas leaving the PAS. These metals concentrations are not anticipated to have a negative impact on the environment as shown in Table 5-2, which gives estimated emission rates and an estimated concentration in the exhaust gas for each metal spiked and the 2003 DCD HHRA emission rate for comparison purposes. Estimated emissions were calculated by multiplying the feed entering the system by a Metals Removal Efficiency (MRE) developed in the MPF Secondary Waste Demonstration Test or a more conservative MRE based on the LIC VX ATB. More conservative MRE were used to account for high chlorine concentrations being present in the feed to the LICs. These calculated emission rates for cadmium, cobalt, copper and nickel are higher than the rates used in the DCD 2003 HHRA, but they are not anticipated to have a negative impact on human health or the environment based on the fact that the calculated concentrations are less than the proposed EPA HWC MACT concentration limits.

The spiking solution will be prepared by dissolving measured amount of metal compounds in an organic solvent. Table 5-3 lists the metal compounds to be spiked and the feed rate of these compounds. Some changes may occur to the list of actual compounds used, but any such changes will be presented to the DAQ and DSHW before the testing begins.

The final metals concentrations in the agent feed are not expected to affect the total metals fed to the LIC. However, no attempt will be made to take the existing agent metals concentrations into consideration in preparation of the metals spiking solutions because of the low anticipated concentrations. Total metals concentrations will be determined by analyses of the mustard and Decon samples, which will be added to the metal feed rate determined from the spiking solutions.

5.1.3 Spent Decontamination Solution Waste Feed

Decon will be fed into the SCC during each of the Performance Runs. Decon is dilute sodium hypochlorite used to decontaminate surfaces exposed to agent. Any organic compounds present will be mainly the oxidation products of mustard, and concentrations of organic compounds are anticipated to be less than 5,000 ppm. Table 1-2 summarizes the anticipated composition of Decon to be used in this ATB. In the case where Decon is not available for use, a solution of NaOCl with a minimum concentration of 1 % will be used for Decon.

TABLE 5-2. METALS SPIKING FEED RATES AND ESTIMATED METALS EMISSION RATES

Agent Feed Rate:	1,275 lb/hr	Mustard Total Metal Feed Rate	Demonstrated Agent GB Feed Rates	Demonstrated Agent VX Feed Rates
Exhaust Gas Flow Rate:	4,400 dscfm			
Exhaust Gas O₂ Conc.:	9.7 %			
FEED CONCENTRATIONS				
Arsenic Conc.:	400 ppm	0.510 lb/hr	0.221 lb/hr	0.381 lb/hr
Cadmium Conc.:	100 ppm	0.128 lb/hr	0.000758 lb/hr	0.054 lb/hr
Chromium Conc.:	100 ppm	0.128 lb/hr	0.0545 lb/hr	0.072 lb/hr
Cobalt Conc.:	50 ppm	0.064 lb/hr	0.0202 lb/hr	0.032 lb/hr
Copper Conc.:	200 ppm	0.255 lb/hr	0.140 lb/hr	0.135 lb/hr
Lead Conc.:	1000 ppm	1.28 lb/hr	0.784 lb/hr	0.790 lb/hr
Manganese Conc.:	200 ppm	0.255 lb/hr	0.121 lb/hr	0.122 lb/hr
Nickel Conc.:	500 ppm	0.64 lb/hr	0.455 lb/hr	0.46 lb/hr
Zinc Conc.:	400 ppm	0.51 lb/hr	0.286 lb/hr	0.240 lb/hr

EXHAUST GAS CONCENTRATIONS					HHRA Emission Rate g/sec	MACT Conc. @7% O₂ µg/dscm
	Removal Efficiency %^a	LIC HD ATB MRE %^b	Emission Rate g/sec	Conc. @7% O₂ µg/dscm		
Arsenic	99.996	99.985	9.64E-06	5.8	2.54E-05	
Cadmium	99.994	99.948	8.35E-06	5.0	4.49E-06	
Chromium	99.96	99.9981	3.05E-07	0.18	5.57E-06	
Cobalt	99.987	99.87	1.04E-05	6.2	8.99E-06	
Copper	99.992	99.920	2.57E-05	15.3	1.09E-05	
Lead	99.997	99.988	1.93E-05	11.5	5.53E-05	
Manganese	99.96	99.600	1.29E-04	76.7	2.87E-04	
Nickel	99.997	99.97	2.41E-05	14.4	8.99E-06	
Zinc	99.882	99.965	2.25E-05	13.4	2.65E-04	
Semi-Volatile Metals				16.5		230
Low-Volatility Metals				5.9		92

Notes:

The MACT Limit for Semi-Volatile Metals is the summation of Pb + Cd = 230 µg/dscm.

The MACT Limit for Low Volatility Metals is the summation of As + Be + Cr = 92 µg/dscm.

^a MRE taken from LIC VX ATB.

^b The MREs for As, Cd, Cr, Pb, and Zn were taken from the SWDT. The other values were conservatively estimated from the LIC VX ATB Data.

TABLE 5-3. LIC PCC METALS SPIKING SOLUTIONS SUMMARY

ELEMENT	SPIKING COMPOUND	ELEMENTAL CONC. * (Wt.%)	SOLUTION FEED RATE (lb/hr)	METAL FEED RATE (lb/hr)
Solution A	In ethylene glycol		15	
Arsenic	Sodium Arsenate	3.4		0.510
Cadmium	Cadmium Acetate	0.9		0.135
Solution B	In mineral spirits		20	
Chromium	Chromium Octanoate	0.65		0.13
Cobalt	Cobalt 2-Ethylhexanoate	0.30		0.060
Copper	Copper 2-Ethylhexanoate	1.25		0.250
Lead	Lead Napthenate Complex	6.4		1.28
Manganese	Manganese 2-Ethylhexanoate	1.25		0.250
Nickel	Nickel 2-Ethylhexanoate	3.2		0.64
Zinc	Zinc 2-Ethylhexanoate	2.5		0.50

* The total concentration will be a sum of the spiking concentration, the concentration from the Decon, and the concentration present in the agent from the TCs.

5.1.4 Surrogate Hazardous Air Pollutant Feed Stream

Organic compounds will be present in the Decon solutions fed to the SCC. There is a potential that some of these compounds will be HAPs. As a part of this test, a surrogate HAP will be fed to the SCC to demonstrate a DRE for HAPs fed to the SCC. Chlorobenzene was selected to be the surrogate HAP because it is a Class 1 compound in the EPA's thermal stability ranking system (5). The EPA guidance indicates that a Class 1 compound can act as a surrogate for the other Class 1 compounds and any other compound with a lower thermal stability. The chlorobenzene will be fed by the spiking subcontractor to the SCC as a separate feed stream with its own pump and mass flow meter to document the feed rate to the SCC.

5.2 PRINCIPAL ORGANIC HAZARDOUS CONSTITUENT SELECTION RATIONALE

Two waste streams will be fed during the LIC Mustard ATB. The liquid mustard consists of a collection of organic compounds that resulted from the manufacture of mustard or the decomposition of these compounds. Mustard was selected as the POHC for the LIC Mustard ATB based on incinerability, toxicity, and concentration. Mustard is representative of the other compounds present in terms of thermal stability and the difficulty of incinerability. It is also the most toxic of the compounds present in the feed to the LICs. The RCRA permit requires the demonstration of a DRE that is $\geq 99.9999\%$. The *bis*(2-chloroethyl)sulfide concentration will average about 89% (see Table 1-1); the other impurities are present at $< 3\%$ each. Considering these characteristics, *bis*(2-chloroethyl)sulfide is the best choice for the LIC Mustard ATB POHC.

The second waste stream fed to the SCC is the Decon waste stream. Table 1-2 shows the range of compounds and concentrations that may be present in the Decon. Some of these compounds are considered HAPs and the MACT regulations require that a DRE be demonstrated for the HAPs. Since the concentration of the HAPs in the Decon could vary depending on the amount of mustard decontaminated by the Decon, it was necessary to demonstrate a known feed rate of a HAP as part of the LIC Mustard ATB. It was decided to use chlorobenzene as the surrogate HAP because it is a Class 1 compound in EPA's thermal stability ranking system. The EPA guidance allows a Class 1 compound to act as a surrogate for the other Class 1 compounds and the other compounds with a lower thermal stability. The use of chlorobenzene as the surrogate allows processing of HAPs with lower thermal stability such as carbon tetrachloride, chloroform, 1,2-dichloroethane, and the other possible compounds that could be present in the Decon. The chlorobenzene feed rate of 10 lb/hr also acts as a surrogate for the total organic compounds in the Decon at an equivalent concentration of 7,800 ppm which is above the current permit limit of 5,000 ppm in the Decon.

5.3 TEST PROTOCOL AND OPERATING CONDITIONS

The LIC Mustard ATB will be conducted to develop emissions data needed to support the performance of direct and indirect risk assessments and to demonstrate compliance with permit conditions and regulatory limits.

5.3.1 Development of Worst-Case Criteria

The LIC Mustard ATB will be conducted at one operating condition, which will demonstrate the minimum temperatures in the PCC and SCC. The maximum feed rates will pose the most stress to the system. Metals will be spiked into the agent feed to produce a “worst case” for metals content to cover the highest anticipated metal concentrations in the mustard and Decon. The Decon metals concentration is expected to be low, since it will only contain the metals collected in the sumps with the Decon. The metals spike will contain arsenic, cadmium, chromium, cobalt, copper, lead, manganese, nickel, and zinc. Metal spiking to the PCC will cover the potential metal concentrations also fed to the SCC. The decontamination of mustard has the potential to have HAPs in the Decon; therefore, a surrogate HAP will be selected and spiked into the Decon feed line to the SCC. The “worst case” operation will be simulated by feeding mustard and metal spiking materials to the PCC and Decon and the surrogate HAP to the SCC.

It is possible that the amount of Decon needed for three successful runs will exceed the supply. If this is the case, a minimum 1.0 % sodium hypochlorite (NaOCl) solution will be used for Decon feed to the SCC.

5.3.2 Liquid Incinerator Mustard Agent Trial Burn Operating Conditions

Table D-3 in Appendix D shows the target Group A operating parameters for the ATB conditions. Samples collected will support the data needs required for updating the DCD HHRA, the RCRA Permit, the Title V air permit, and the HWC MACT emission limits. Final ATB values for these parameters may change slightly based on operational experience gained during the shakedown period. The LIC Mustard ATB will be performed under the following operating conditions:

- Maximum mustard feed rate to the PCC of 1,275 lb/hr.
- There will be two metal spiking solutions fed to the PCC with the mineral spirits solution fed at 20 lb/hr and the ethylene glycol solution fed at 15 lb/hr.
- Maximum Decon feed rate to the SCC of 2,100 lb/hr.
- HAP spiking feed to the SCC of chlorobenzene at 10 lb/hr.
- Minimum PCC temperatures from the range of 2,500 °F to 2,850 °F.
- Minimum SCC temperatures from the range of 1,800 °F to 2,200 °F.
- The residence time through the PCC, SCC, and duct work to the quench tower will be > two seconds as described in Sections 2.1 and 2.2.
- The O₂ concentration will be maintained between 3% and 15%.

- The CO concentration will be below 100 ppm @ 7% O₂.
- Pressure drop across the venturi will be ≥ 30 inWC.
- Normal quench tower and venturi scrubber Brine flows, minimum Brine pH, and maximum density.
- Normal clean liquor flow rate, minimum pH, and maximum density.
- Monitoring of mustard in the LIC duct by an additional ACAMS.

5.3.3 Metals Spiking Operations

A subcontractor specializing in the preparation and feeding of metals spiking solutions for trial burns will prepare the spiking solutions. In addition, this subcontractor will provide the equipment necessary for the metals spiking activities. In addition, the subcontractor will provide personnel whose function and expertise have been proven by participation in trial burns conducted at other hazardous waste incineration facilities.

The metals spiking compounds will be dissolved in an organic solvent to form a solution. Metals will be spiked into the LIC by injecting this solution through the agent feed nozzle. The spiking lines will be equipped with check valves to prevent backflow of agent into the spiking lines. The spiking lines will join with the agent feed line approximately 5 ft before the agent feed gun. Mixing of the spiking solution and agent will occur in the agent feed line and at the feed nozzle, and the resulting mixture will be burned in the PCC. The spiking subcontractor will be in phone contact with the Control Room. If agent feed is lost, the spiking solutions will be stopped. The metals spiking feeds will be restarted when the agent feed is restored.

Metals will be spiked at a high enough rate to ensure reliable data. The spiking rates were more than 10 times the PQL-based feed rate to ensure reliable data. These demonstrated spiking levels will be used to calculate an extrapolated maximum feed rate if the measured emission concentrations are not within 75 percent of the MACT regulatory limits. The measured emissions will be used to calculate a ratio of the regulatory emissions to the measured emissions. The demonstrated feed rates will then be multiplied by the ratio and by 75 percent to determine a maximum feed rate as allowed by the EPA Guidance (5). An example of the calculation follows:

$$\begin{aligned}\text{Ratio} &= (\text{MACT Limit in } \mu\text{g/dscm}) / (\text{Cd} + \text{Pb in } \mu\text{g/dscm}) \\ &= (230 \mu\text{g/dscm}) / (5.0 + 11.5) \mu\text{g/dscm} = 13.9394\end{aligned}$$

$$\begin{aligned}\text{Extrapolated Feed Rate} &= (\text{Cd Feed} + \text{Pb Feed}) * (\text{Ratio}) * 0.75 \\ &= (0.128 \text{ lb/hr} + 1.28 \text{ lb/hr}) * (13.9394) * 0.75 = 14.72 \text{ lb/hr}\end{aligned}$$

The metal spiking subcontractor provides metering equipment (either calibrated flow meters or calibrated and certified scales and metering pumps) that will be used to quantify the rate and amount of spiking solution fed to the LIC. This data, combined with the certified concentrations provided by the metal spiking subcontractor, will be used to determine the metal feed rate attributed to the spiking solution. This feed rate will then be combined with the agent metals feed rate (determined from the metals analysis of the mustard and Decon samples and their feed rates to the LIC) to give an overall metals feed rate for the LIC Mustard ATB. Samples of each spiking solution will be collected for each run.

5.3.4 Surrogate Hazardous Air Pollutant Feed Operations

A subcontractor specializing in the preparation and feeding of spiking solutions for trial burns will conduct the surrogate HAP spiking operations. The subcontractor will provide the equipment necessary for pumping and documenting the spiking feed rates. In addition, the subcontractor will provide personnel whose function and expertise have been proven by participation in trial burns conducted at other hazardous waste incineration facilities. The surrogate HAP, chlorobenzene, will be fed as a pure solution to the feed line to the Decon feed nozzle in the SCC. Chlorobenzene will be spiked into the SCC by injecting this solution through the Decon feed nozzle. The spiking lines will be equipped with check valves to prevent backflow of Decon into the spiking line. The spiking line will join with the Decon feed line approximately 15 ft before the Decon feed nozzle.

Mixing of the spiking solution and Decon will occur in the feed line and at the feed nozzle, and the resulting mixture will be burned in the SCC. The spiking subcontractor will be in phone contact with the Control Room. If agent feed is lost, the spiking solution will be stopped. The spiking solution will be restarted when the agent feed is restored.

The spiking subcontractor will provide the metering equipment (either calibrated flow meters or calibrated and certified scales and metering pumps) that will be used to quantify the rate and amount of spiking solution fed to the SCC. This data, combined with the purity data from the chemical supplier, provided by the spiking subcontractor, will be used to determine the chlorobenzene feed rate. Samples of the chlorobenzene will be collected for each run and held for archival interest only. No analyses of the chlorobenzene samples will be done unless subsequent problems indicate the need for analyses of the samples.

5.4 COMBUSTION TEMPERATURE RANGES

The anticipated PCC temperatures for this ATB will be between 2,500 °F and 2,850 °F. These temperatures are from the AWFCO tables located in Appendix D. Experience with the LICs indicates that the temperatures vary within this temperature range. The SCC temperature will be between 1,800 °F and 2,200 °F, which are the AWFCO limits from the tables located in Appendix D. Minimum temperature limits will be established by the LIC Mustard ATB.

5.5 WASTE FEED RATES AND QUANTITIES OF WASTES TO BE BURNED

Mustard feed rates for the LIC Mustard ATB will be up to 1,275 lb/hr. Decon feed will be up to 2,100 lb/hr. The feed materials will be mustard, Decon, an organic HAP surrogate and the metals spiking solutions. This ATB will require mustard and Decon to be fed to the LIC for a minimum of 18 hours. The quantity of mustard burned during the ATB will be about 21,357 pounds based on a feed rate of 1,275 lb/hr. The quantity of Decon processed during the ATB will be about 35,154 pounds based on a feed rate of 2,100 lb/hr. Allowing a 25 percent safety factor, the consumption of test feed materials is expected to be about 27,000 pounds of mustard, 44,000 pounds of Decon, 400 lb of mineral spirits metals spiking solution, 300 lb of ethylene glycol metals spiking solution, and 200 lb of chlorobenzene. The anticipated usage rates are summarized in Table 5-4. Metal spiking feed usage will be finalized by the spiking subcontractor.

The LIC will reach equilibrium at test conditions with mustard and Decon supplemented by natural gas about 15 minutes before the start of each sampling run. A surplus of mustard, Decon, metal spiking solutions, and chlorobenzene will be on hand in case operational problems require a longer testing period. After each performance run is completed, the feed materials remaining may be processed through the LIC.

**TABLE 5-4. WASTE FEED REQUIREMENTS FOR THE LIQUID INCINERATOR
MUSTARD AGENT TRIAL BURN**

Activity	Mustard Required (lb)	Decon Required (lb)	Metals Spiking Solution A (lb)	Metals Spiking Solution B (lb)	Surrogate HAP Required (lb)
Ramp up, 20 min	425	693	0		0
Steady-State Operations, 15 min	319	525	5.0	3.75	2.5
Exhaust Gas Sampling, 5 hr	6,375	10,500	100	75	50.0
Total per Performance Run	7,119	11,718	105	78.75	52.5
Total for Three Performance Runs	21,357	35,154	315	236	157.5

5.6 EXHAUST GAS VELOCITY INDICATOR

Exhaust gas flow rates for the LICs are measured with a V-Cone® flow meter, installed in the exhaust duct located after the scrubber tower and before the demister to measure the volumetric flow rate. The V-Cone® is positioned in the center of the pipe to increase the velocity of the exhaust flow, which creates a differential pressure. The pressure difference is measured and converted to an scfm flow rate. The LIC control system records the value and generates a HRA.

If the HRA setpoint is exceeded, the PLC causes a stop feed and an alarm. A maximum exhaust gas velocity will be established by the LIC Mustard ATB.

5.7 AUXILIARY FUEL

Natural gas will be used as required to maintain temperatures in both the PCC and SCC. Natural gas also is used as pilot burner fuel for both the PCC and the SCC. The average composition of the natural gas from June 2005 is shown in Table 5-5.

TABLE 5-5. AVERAGE NATURAL GAS COMPOSITION

PARAMETER	AVERAGE VALUE *
Heating Value (Btu/ft ³)	1043
Specific Gravity (lb/ft ³)	0.5857
Nitrogen (mole %)	0.41
Carbon Dioxide (mole %)	0.52
C1 (mole %)	95.60
C2 (mole %)	2.5
C3 (mole %)	0.631
C4 (mole %)	0.117
iso-C4 (mole %)	0.116
n-C5 (mole %)	0.028
iso-C5 (mole %)	0.039
C6 (mole %)	0.021
C7 (mole %)	0.012
C8 (mole %)	0.005
C9 (mole %)	0.0006

* Monthly average from June 2005.

5.8 WASTE FEED ASH CONTENT

Ash generated during the LIC Mustard ATB will potentially come from the metals present in the mustard, the metal spiking feed, and the Decon. Based on the metals concentrations from Table 1-1, the metals in the mustard will not contribute to the estimated ash feed rate. Similar metals spiking solutions will be used for the LIC Mustard ATB as were used for the LIC VX ATB, so the LIC VX ATB data were used to estimate ash feed rate. The Decon ash feed rate was estimated from the total suspended solids and total dissolved solids from the LIC VX ATB Decon analyses.

An average estimated ash feed rate was calculated from the average ash feed rate from metal spiking solutions (3.02 lb/hr) plus the average ash feed rate from the Decon (184.5 lb/hr) for a total of 188 lb/hr. The maximum estimated ash feed rate was calculated from the maximum ash feed rate from the metal spiking solutions (3.27 lb/hr) and the maximum ash feed rate from the Decon (257.6 lb/hr) for a total of 261 lb/hr.

The potential ash generated will be divided between slag formation and particulate emissions. The slag will be sampled at the conclusion of the ATB. Ash particles exiting the SCC will be collected by the PAS Brine or measured in the LIC duct. No spiking of the waste feeds will be done to generate ash or PM.

5.9 ORGANIC CHLORINE CONTENT OF THE WASTE FEED

Mustard contains organic chlorine in the agent molecule and the impurities listed in Table 1-1. Organic chlorine feed rates for the LIC Mustard ATB are summarized in Table 5-6. The feed rate for an average composition of the mustard is 529 lb/hr and range up to a maximum organic chlorine feed rate of 613 lb/hr. Any chlorine measured in the LIC duct will probably be attributed to the combustion of the organic chlorine present in the feed. Some HCl and Cl₂ in the exhaust gas will also be attributed to the decomposition of the sodium hypochlorite in the Decon treated in the SCC. Concentrations of HCl and Cl₂ in the LIC emissions will be sampled using Method 0050 (1) and analyzed by Method 9057 (1). Details are given in the QAPP (Appendix A).

5.10 METALS FEED RATES

There are only trace amounts of metals in mustard as shown in Table 1-1; therefore, the Agent will be spiked to the feed rates shown in Table 5-2. Metals emissions will be sampled using Method 29 (2). Sampling and analysis details for metals emissions are given in the QAPP (Appendix A).

TABLE 5-6. TOTAL CHLORINE FEED RATES

Organic Compounds	Average Value Wt. %	Maximum Value Wt. %	Organic Chlorine Wt. %	Average Organic Chlorine Wt. %	Maximum Organic Chlorine Wt. %
<i>Bis</i> (2-Chloroethyl)sulfide	89.31	101	44.57	39.81	45.02
1,2-Dichloroethane	0.606	0.993	71.65	0.43	0.71
Tetrachloroethene	0.0502	0.0734	85.51	0.04	0.06
1,1,2,2-Tetrachloroethane	0.0518	0.0588	84.49	0.04	0.05
T	0.169	0.355	26.93	0.05	0.10
Q	3.24	5.66	32.35	1.05	1.83
Hexachloroethane	0.210	0.293	89.85	0.19	0.26
Totals	93.64	108.43		41.61	48.03
				Average Chlorine Feed Rate (lb/hr)	Maximum Chlorine Feed Rate (lb/hr)
Mustard Feed Rates	1,275			530.5	612.4
Decon Feed Rates	2000		2.038	40.8	40.8
Chlorobenzene Feed Rate	10		31.5	3.2	3.2
Total Chlorine Feed Rate				574.4	656.3

5.11 POLLUTION CONTROL EQUIPMENT OPERATIONS

Operation of the pollution control equipment is provided in this section as required by 40 CFR 270.62(b)(2)(vi). The anticipated operating conditions for the LIC Mustard ATB are the same as standard operating conditions and are summarized in Appendix D. Fluctuations in PAS temperatures, flow rates, pressures, pH, and density will occur during this trial burn. These normal variations will be reported in the final LIC Mustard ATB Report. Standard operating conditions for the pollution control equipment are described in Section 2.10.

5.12 SHUTDOWN PROCEDURES

The shutdown procedures to be observed during the LIC Mustard ATB are discussed in this section as required by 40 CFR 270.62(b)(2)(vii). The AWFCOs for Group A are continuously monitored and interlocked. Group C parameters, which are monitored and interlocked, will be in operation during this ATB. In addition, the system's operation will be monitored closely by the system operators. If the operation of the system should deviate significantly from the desired range of operation or become unsafe, the operators will manually shut off waste feeds to the system. The AWFCO system and parameters for shutting down the waste feeds are described in Section 2.8.

Sampling will be stopped if an AWFCO is activated during the LIC Mustard ATB. Should the AWFCO condition persist for 2 hours, the run will be aborted. A run will also be aborted if more than three AWFCOs occur during one traverse of the four-hour sampling trains. If the DAQ and DSHW representatives approve continuing a run after either of the abort conditions is reached, the approval will be documented and included in the deviation discussions in the final report.

It may be necessary to shut down the LIC and LIC PAS completely in the event of a major equipment or system failure. A shutdown of this type will be performed in strict accordance with the facility's standard operating procedures. Shutdown will be the reverse of the startup process described in Section 2.13.

Subsystems will be shut down in the following order:

1. LIC PCC and SCC
2. PAS
3. Utilities

Sampling will be stopped if a power failure occurs during a run. Waste feeds to the system will be stopped, but other operating parameters will be maintained to minimize emissions. Combustion air will continue to be supplied as the ID fans spin down.

5.13 INCINERATOR PERFORMANCE

Incinerator performance is discussed in this section as required by 40 CFR 270.62(a). The TOCDF believes that the conditions specified in Section 5.3 for the trial burn will be adequate to meet the performance standards of 40 CFR 264.343 while firing mustard, Decon, and the spiking solutions because:

- TOCDF experience with both LICs burning Agents GB and VX under practically identical operating conditions shows that the expected DRE will exceed 99.9999 %. In trial burn tests conducted at Johnston Atoll Chemical Agent Disposal System (JACADS), mustard DREs exceeding 99.9999 % were also achieved.
- TOCDF experience with the LIC burning Agents GB and VX under similar operating conditions suggests that the HCl and PM emissions will be less than the respective performance standards.
- The ranges of operating conditions planned for this ATB are within the design envelope of the LIC and LIC PAS.
- The LIC and LIC PAS are tightly controlled by PLCs and AWFCO systems whenever hazardous waste is being fed to the LIC.
- One test condition will be used to establish the operating envelope for the LICs. The TOCDF LICs are operated as steady-state, base-loaded incinerators, and the test condition will demonstrate the minimum temperatures and the Extreme Temperature Limit (ETL) will set the upper temperature limits. Combustion air flow and velocity fluctuates as necessary to maintain the proper negative pressure in the furnace. The fluctuations in metal and chlorine feed rates should be minor.

6.0 MUSTARD SHAKEDOWN PROCEDURES

LIC1 and LIC2 have been processing agent and Decon since August 1996 and July 1997, respectively. Thus, all systems and startup testing has been performed on both incinerators. Once the approval of this ATB plan is received from the appropriate regulatory agencies, shakedown will commence as described in Section 6.2. During the shakedown period, the entire system will be thoroughly tested to verify that it performs in a safe, consistent, and predictable manner when processing mustard.

Shakedown testing will proceed in accordance with the TOCDF LIC Mustard ATB Shakedown Plan (see Appendix B). This shakedown plan defines all activities, methodologies, shakedown criteria, and compliance actions associated with the testing of the system. As stated in the shakedown plan, operating conditions will be maintained within the envelope of anticipated final operating limits (defined in Appendix D) throughout the shakedown period. These limits on operating conditions are based on good engineering practice, over nine years of experience processing Agents GB and VX in the LICs, and feedback from the JACADS Mustard Agent Campaign. Operating limits will comply with the requirements of 40 CFR 270.62(a)(1). Proposed operating conditions are preliminary, and final values will be confirmed or modified as shakedown progresses.

Hazardous wastes will not be fed to the system at any time unless the conditions discussed above are satisfied. The flow of hazardous waste to the incinerator will be stopped if operating conditions deviate from the established limits. The AWFCO system, described in Section 2.8, will be in operation at all times during the incineration of hazardous wastes, and the settings during shakedown will be those specified in Appendix D. Individual AWFCOs for those parameters that may cause total incinerator shutdown (such as auxiliary fuel, burners, or ID fan) may be bypassed momentarily during routine calibrations. Those calibrations that require the AWFCOs to be bypassed will not be conducted when waste is in the furnace.

6.1 STARTUP PROCEDURES AFTER AGENT CHANGE-OVER

The startup periods for the LICs will be short because the systems have been in operation for over nine years. The LIC systems will be heated until operating conditions have been reached. Temperatures will be held at operating conditions for 48 hours to verify that all systems are operating correctly. During this 48-hour period, operation of the PAS and CEMS will be verified, and the AWFCO system will be tested to verify that all AWFCOs are operational. The systems will then be declared ready for operation and the shakedown period will begin. The DAQ and DSHW will be notified of the AWFCO test 7 days in advance.

6.2 MUSTARD SHAKEDOWN

The objectives of the shakedown are to:

- Demonstrate that the LICs can safely and efficiently destroy mustard at the proposed permit rate.
- Familiarize the operators with the differences in operations for burning mustard.
- Verify that all systems function properly after Agents GB and VX decontamination and changeover of any necessary equipment for mustard operations.
- Verify that the agent feed ramp-up rate is suitable for mustard.
- Verify that the Decon feed ramp-up rate is suitable for NaOCl solutions.
- Develop agent characterization data for mustard by analyzing samples taken from the discharge of the ACS tanks or bulk containers.
- Evaluate the LIC operating conditions required for permit compliance.
- Evaluate the impact on the SCC of simultaneously processing mustard and Decon.

During shakedown, TOCDF will commence operations of all furnaces. TOCDF will provide the DAQ and DSHW with notice before introducing hazardous wastes into the system. Mustard will be introduced into the LIC in accordance with 40 CFR 264.344(c)(1) to bring the unit to a point of operational readiness for the trial burn. This phase will take four to six weeks and consist of up to 720 hours of agent processing. If TOCDF determines that more time is necessary to ensure operational readiness before the trial burn, an extension of up to 720 additional hours of operating time will be requested.

The shakedown period will involve a series of tests as described in the shakedown plan (see Appendix B). Shakedown will also include monitoring of the POHC (mustard) using both ACAMS and DAAMS. The TOCDF may request final modifications to the LIC Mustard ATB Plan based on data obtained during the shakedown period. If such changes are necessary, they will be coordinated with the DAQ and the DSHW.

6.3 POST MUSTARD AGENT TRIAL BURN OPERATION

The interim period between completion of the LIC Mustard ATB and receipt of final approval from DSHW for full operating authority could be several months. During this time, TOCDF intends to continue operating the LICs on a full-time basis, under all federal requirements per 40 CFR 264, 266, and 270. The TOCDF expects the LICs to operate during this period within the operating envelope defined and demonstrated by the ATB, with the exceptions of mustard feed rates. Mustard feed rates shall be limited to 50 % of the average rates demonstrated during the trial burn until approval of preliminary data by the Executive Secretary. After approval of the preliminary data, feed rates will be increased to 75 % of the rate demonstrated during this ATB. When the report is submitted to DSHW and the Notice of Compliance is submitted to DAQ, the feed rate will be increased to 100 % after review of the ATB Report's Executive Summary by the DEQ Executive Secretary.

The inspection plan will be followed including visual inspection of the incinerator for fugitive emissions, leaks, and associated equipment spills and for signs of tampering, per 40 CFR 264.347(b). All appropriate operating records will be maintained for documentation of operating conditions.

The AWFCO system and associated alarms, as described in Section 2.8, will function any time hazardous waste is in the combustion zone of the incinerator. The AWFCOs will be tested according to the established schedule. Test methods for the AWFCOs will remain unchanged from the methods specified in the RCRA and air permits.

6.4 INCINERATOR PERFORMANCE

TOCDF believes that the conditions specified in Section 6.0 for the startup, shakedown, trial burn, and post-trial burn operation will be adequate to meet the performance standards of 40 CFR 264.343 while processing mustard and Decon because:

- TOCDF experience with the LICs burning Agents GB and VX and Decon under similar operating conditions shows that the expected DRE will exceed 99.9999 %.
- Experience at the TOCDF with the LICs burning Agents GB and VX and Decon under similar operating conditions suggests that the HCl and Cl₂ emissions will be < 32 ppm and the PM emissions concentrations will be less than 29.7 mg/dscm. These estimated emissions are within the performance standards.
- TOCDF experience with the LICs during incineration of Agents GB and VX spiked with metals resulted in metal emissions that did not pose a threat to human health or the environment.
- The range of operating conditions planned for the shakedown and post-trial burn periods are within the design envelope of the LIC and LIC PAS (refer to the Appendix C MEBs).
- The LIC and LIC PAS will be tightly controlled by the PLCs, and the AWFCO systems will be operational at all times during the shakedown and post-trial burn periods.

In addition, meeting the performance standards of 40 CFR 264.343 and limiting metal emissions rates to values less than those used in the 2003 DCD HHRA (See Table 5-2) ensures protection of human health and the environment.

7.0 MUSTARD AGENT TRIAL BURN SUBSTITUTE SUBMISSIONS

This section is not applicable since an ATB will be conducted.

8.0 MUSTARD AGENT TRIAL BURN RESULTS

The results of the LIC Mustard ATB will be submitted in the report format specified in Appendix G. The key elements that will be included in each section of the trial burn report include:

- A summary of trial burn results describing any unusual process conditions (i.e., deviations from the approved LIC Mustard ATB Plan) or difficulties experienced with sampling, testing, or analysis (Executive Summary).
- A discussion of any inconsistencies in the data and assessment of/justification for usability of the data (Executive Summary).
- A summary of conclusions in meeting the LIC Mustard ATB Plan objectives (Executive Summary).
- A description of the facility information and test objectives (Section 1.0)
- An overview of the project and a list of key project personnel by functional position (Section 2.0).
- A comparison of test conditions to planned conditions for information on all waste feed rates, waste generation rates, and LIC PAS exhaust gas parameter rates, including at a minimum (from Section 3.0):
 - Maximum, minimum, average, and standard deviation of the mustard and Decon feed rates.
 - Maximum, minimum, average, and standard deviation of combustion chamber temperatures.
 - Maximum, minimum, average, and standard deviation of PAS operating conditions.
 - Maximum, minimum, average, and standard deviation of exhaust gas velocity.
 - Exhaust gas concentrations of O₂, CO, and CO₂ .
- A description of mustard sampling and analyses results for neat agent and exhaust gas concentrations (Section 4.0).
- A summary of test results and a comparison with permit or regulatory compliance limits, including (from Section 5.0):
 - Analytical results.
 - Exhaust gas concentrations and exhaust gas emission rates (pounds per hour) of metals, HCl, Cl₂, PM, PCDDs and PCDFs, PICs, and THC.

- A description of sampling methods, sample preparation, and analytical procedures for process samples (see Section 6.0).
- A discussion of the ATB results (Section 7.0)
- A discussion of the data developed for the MACT and Title V permit requirements (Section 8.0)
- A brief summary of the quality control results (Section 9.0)
- A statement of the conclusions to be drawn from the ATB (Section 10.0)
- Example calculations for key data (see Appendix A).
- An exhaust gas sampling report including sampling equipment calibration data (see Appendix B).
- PDARS data (see Appendix C).
- CEMS data (see Appendix D).
- A Quality Assurance/Quality Control (QA/QC) report, including a key that relates laboratory sample identification numbers to trial burn sample identification numbers and QC Criteria performance (see Appendix E).
- Mustard characterization data (see Appendix F).
- Mustard analyses by ACAMS and DAAMS (see Appendix G).
- Field GC VTOC Data Package (see Appendix H).
- Report from the spiking subcontractor on the feed rate data for the spiking solutions (see Appendix I).
- Analytical data package from the SMVOC samples (see Appendix J)
- Analytical data package for Process Samples and Emission Samples (see Appendix K).

TOCDF will submit the LIC Mustard ATB Report within 90 days after completion of the trial burn. The trial burn report will be certified in accordance with the requirements of 40 CFR 270.62(b)(7-9). It should be noted that all data will be submitted for all analyses conducted, including the data from any failed runs.

9.0 FINAL OPERATING LIMITS

9.1 ESTABLISHING LIQUID INCINERATOR OPERATING PARAMETERS

The LIC Mustard ATB demonstration of DRE, mustard feed rates, Decon feed rates, metal emissions, PM emissions, halogen emissions, and PIC emissions will be used to establish the operating permit limits for the LICs. The successful completion of this ATB will establish the operating permit at the levels discussed in this section.

The destruction of organic compounds is a function of time, temperature, and turbulence. The combustion temperatures and gas velocities in the system demonstrate operating conditions that ensure the destruction of organic compounds and avoid PIC formation. The waste feed rates demonstrated during this ATB will present the maximum challenge for the PM loading to the LIC PAS. The pH of the Brine in the PAS will control the emission of acid gases present in the exhaust gas.

The anticipated final operating conditions resulting from the LIC Mustard ATB are summarized in Appendix D. These tables were prepared following the hierarchy of process-control-related performance parameters, as established by EPA guidance (5). Each anticipated LIC final operating limitation is listed by process parameter, target value during the trial burn, and anticipated manner by which the limit will be established. In accordance with EPA guidance, the process parameters presented in Appendix D are broken down by Group A, B, and C parameters, as follows:

- Group A – These parameters will be monitored continuously and will be connected to an AWFCO system. When a Group A parameter is exceeded, contaminated waste feed must be discontinued immediately. Group A parameters will be established based on demonstrated operating conditions during the trial burn.
- Group B – These parameters will not be monitored continuously. Compliance with these parameters will be based on operating records to ensure that routine operation is within the operational limits established by the trial burn.
- Group C – Limits on these parameters will be set independent of trial-burn-demonstrated parameters. Instead, these limits will be based on EPA guidance, equipment manufacturer's design and operating specifications, operational safety considerations, and good engineering practices. Group C parameters include parameters monitored both continuously and periodically. Depending upon the particular Group C parameter, a Group C parameter may or may not be an AWFCO parameter.

9.2 GROUP A PARAMETERS

Establishment of permit limits for the Group A parameters is discussed in the following paragraphs:

- **Maximum Hazardous Waste Feed Rates** – Maximum mustard and Decon feed rates will be Group A parameters. The LIC Mustard ATB will be performed as close to the maximum mustard and Decon feed rates as possible. The final approved permit limit for each waste feed stream will be the demonstrated feed rates that achieved a minimum DRE of 99.9999 %.
- **Minimum PCC Temperature** – Minimum PCC temperature will be a Group A parameter related to meeting the DRE. The minimum PCC temperature will be demonstrated during the LIC Mustard ATB, provided that a DRE of at least 99.9999 % is demonstrated.
- **Minimum SCC Temperature** – Minimum SCC temperature will be a Group A parameter related to DRE and metal emissions. The minimum SCC temperature will be demonstrated by the LIC Mustard ATB, provided that a DRE of at least 99.9999 % is demonstrated.
- **Maximum Exhaust Gas Velocity** – Exhaust gas velocity (measured at the scrubber exit with V-Cone® ΔP) will be a Group A parameter related to DRE and gas treatment. Gas velocity in the LIC Duct is an indicator of exhaust gas residence time in the LIC. The final approved operating conditions will be determined from the LIC Mustard ATB results.
- **Minimum Brine Flow to the Venturi Scrubber** – Minimum Brine flow rate to the venturi scrubber will be a Group A parameter that is related to metal emissions and PM emissions. The final approved permit limit for minimum Brine flow to the venturi scrubber will be based on the LIC Mustard ATB results, provided the ATB demonstrates acceptable metals emissions and PM concentrations < 29.7 mg/dscm.
- **Minimum Venturi Scrubber Differential Pressure** – The minimum differential pressure across the venturi scrubber will be a Group A parameter related to metal and PM emissions. The final approved permit limit for minimum venturi scrubber differential pressure to the venturi scrubber will be determined during the LIC Mustard ATB provided acceptable metal and PM emissions are demonstrated.
- **Minimum Brine and Clean Liquor pH** – The minimum Brine and clean liquor pH will be a Group A parameter related to acid gas emissions. The minimum Brine and clean liquor pH will be determined based on the LIC Mustard ATB results, provided adequate acid gas control is demonstrated.

- Maximum Brine and Clean Liquor Density – The maximum Brine and clean liquor density will be a Group A parameter related to acid gas and PM emissions. The maximum Brine and clean liquor density will be determined based on the LIC Mustard ATB results, provided control of acid gas and PM emissions are demonstrated.
- Minimum Clean Liquor Flow Rate – The minimum clean liquor flow rate will be a Group A parameter related to acid gas and PM emissions. The minimum clean liquor flow rate will be determined based on the LIC Mustard ATB results, provided control of acid gases and PM emissions are demonstrated.

9.3 GROUP B PARAMETERS

Establishment of Group B parameter limits based on the LIC Mustard ATB is discussed in the following paragraphs:

- POHC DRE – A DRE of 99.9999 % or greater for mustard will be demonstrated by the ATB. This DRE demonstration will allow TOCDF to process the mustard contained in the munitions in the DCD Stockpile. For purposes of this ATB, agent will include mustard and the organic impurities found in the munitions.
- Maximum Metals Feed Limits – Metal feed limits will be set by the metals feed rates demonstrated during the LIC Mustard ATB. The demonstrated rate will be a sum of the metals in the agent feed, Decon feed, and the metals added through the metals spiking solutions. Concentrations of metals in the exhaust gas will be measured and compared to the 2003 DCD HHRA limits. TOCDF expects to meet the permit limits while processing mustard at 1,275 lb/hr and Decon at 2,100 lb/hr.
- Maximum PM Emissions – The PM emissions will be measured during the LIC Mustard ATB. The ATB will be considered an acceptable PM test for mustard and Decon, provided the PM concentration is ≤ 29.7 mg/dscm corrected to 7% O₂.
- Maximum Emissions of Chlorine and Hydrogen Chloride – The expected permit condition for this parameter is 32 ppm, as required under the MACT Limits.
- Maximum PCDD/PCDF Emissions – The expected permit condition for these parameters will be 0.4 ng/dscm of 2,3,7,8-TCDD TEQ corrected to 7% O₂.

9.4 GROUP C PARAMETERS

Establishment of Group C parameters are discussed in the following paragraphs:

- CEMS Operation – CEMS operation will be a Group C parameter to comply with EPA guidance that CEMS must be operational when the LIC is processing wastes. A loss of instrument signal from both of the CO monitors or both O₂ monitors will result in an AWFCO.
- Maximum PCC Temperature – Maximum PCC temperature will be a Group C parameter based on the manufacturer's recommendations of an ETL. The final approved permit limit for maximum PCC temperature will be the ETL.
- Maximum SCC Temperature – Maximum SCC temperature will be a Group C parameter based on the manufacturer's recommendations of an ETL. The final approved permit limit for maximum SCC temperature will be the ETL.
- Maximum Quench Tower Exhaust Gas Temperature – Quench tower exhaust gas temperature will be a Group C parameter based on the manufacturer's recommendations. The maximum temperature limit proposed for the quench duct exit temperature will be 225 °F to protect temperature-sensitive construction materials in the remainder of the PAS. When the quench tower duct exit temperature exceeds the maximum limit, all waste feeds are stopped.
- Minimum Quench Brine Pressure – The minimum quench Brine pressure will be a Group C parameter related to metal emissions and PM emissions. The final approved permit limit for minimum quench Brine pressure should remain at 40 psig, provided the LIC Mustard ATB demonstrates acceptable metal emissions and PM concentrations < 29.7 mg/dscm.
- Minimum Clean Liquor Pressure – The minimum clean liquor pressure will be a Group C parameter related to acid gas and PM emissions. The final approved permit limit for minimum clean liquor pressure should remain at 15 psig, provided the LIC Mustard ATB demonstrates control of acid gases and PM emissions.
- Maximum CO Concentration at the Blower Exhaust – Maximum CO concentration at the blower exhaust will be a Group C parameter related to PIC control. The performance standard for CO is a HRA of 100 ppm_{dv} corrected to 7% O₂. Waste feeds will not be resumed until the HRA concentration falls below the 100-ppm_{dv} HRA limit. The final approved permit limit for the HRA CO concentration should remain at 100 ppm_{dv} corrected to 7% O₂, dry volume, provided acceptable PIC control is demonstrated.

- Minimum and Maximum Oxygen Concentration at the Blower Exhaust – Oxygen concentration in the blower exhaust will be a Group C parameter. The LIC will be operated under oxidative operating conditions to treat the waste feeds. The oxygen levels in the combustion system will be controlled to a concentration between 3 and 15 % O₂ at the lower exhaust. The final approved permit limit for minimum and maximum oxygen at the blower exhaust will remain 3 % and 15 %, respectively, provided the POHC DRE and PIC levels are satisfactory.
- Maximum Thermal Input to PCC – An upper limit on the thermal input to the PCC is 14 million Btu/hr, based on the recommendations of the manufacturer.
- Maximum Thermal Input to SCC – An upper limit on the thermal input to the SCC is 8 million Btu/hr, based on the recommendations of the manufacturer.
- Slag Removal System Discharge Gate Open – Sound operating practice dictates that the slag removal system discharge gate be closed prior to commencing waste feed.
- High SRS Shell Temperature – Theoretically, an electrical control failure could cause the SRS heaters to overheat the SRS shell with an incumbent loss of structural integrity. Stopping waste feed automatically before this occurs will prevent agent leakage that might result from structural failure.
- Minimum Agent Feed Nozzle Pressure at High Feed Rate – Sound operating practice dictates that the environment be protected against massive agent leaks. Were a major leak to occur in agent feed piping, an AWFCO immediately stops all feed.
- Minimum Agent Atomizing Air Pressure – The lower limit on air pressure to the agent gun is 60 psig, based on operating experience and the recommendations of the PCC burner manufacturer.
- Minimum Decon Atomizing Air Pressure – The lower limit on the air pressure to the SCC spray nozzle is 60 psig, based on operating experience and the recommendations of the liquid waste nozzle manufacturer.
- Maximum Quench Brine Density – Experience has shown that if the Brine becomes too dense due to the dissolved salts, nozzles can be clogged and piping may be plugged. Thus, the upper limit on Brine density is a specific gravity of 1.20.
- Minimum Capacity of the Brine Surge Tanks – To prevent overfilling the Brine tanks from the PAS if density or levels become unacceptable, an AWFCO will result if all four Brine surge tanks reach their high-high level of 18 ft 3 inches.

- Maximum Mustard Stack Concentration – Scientific research has determined the maximum SEL for each agent to ensure that there is no threat to workers or the general public. The ACAMS will initiate an AFWCO if common stack mustard concentrations exceed the Appendix D setpoint.
- Maximum Mustard Duct Concentration – Scientific research has determined the maximum SEL for each agent to ensure that there is no threat to workers or the general public. An ACAMS will initiate an AFWCO if LIC duct mustard concentrations exceed the Appendix D setpoint.

10.0 REFERENCES

- (1) ***Test Methods for Evaluating Solid Waste, Physical/Chemical Methods***, 3rd Edition, including Update III, USEPA, SW-846, December 1996.
- (2) Title 40, ***Code of Federal Regulations***, Part 60, Appendix A, “Test Methods.”
- (3) **Attachment 20 to the TOCDF Permit, *CEMS Monitoring Plan***, EG&G Defense Materials, Inc., **CDRL-06**.
- (4) ***Hazardous Waste Combustion Unit Permitting Manual, Component 1***, “How to Review A Trial Burn Plan,” U.S. EPA Region 6, Center for Combustion Science and Engineering, 1998.
- (5) ***Guidance on Setting Permit Conditions and Reporting Trial Burn Results***, EPA/625/6-89/019, January 1989.
- (6) ***Guidance for Total Organics***, Final Report, EPA/600/R-96-036, March 1996.
- (7) **Attachment 22 to the TOCDF Permit, *Agent Monitoring Plan***, EG&G Defense Materials, Inc., TOCDF CDRL 23.
- (8) Title 40, ***Code of Federal Regulations***, Part 60, Appendix B, Specification 4B “Standards of Performance for New Stationary Sources.”
- (9) Title 40, ***Code of Federal Regulations***, Part 60, Appendix B, “Performance Specifications.”
- (10) “Standard Practices for Sampling Water from Closed Conduits,” ***ASTM D 3370-95a*** (Reapproved 1999), ASTM International, West Conshohocken, Pennsylvania.
- (11) “Standard Practice for Sampling with a Scoop,” ***ASTM D 5633-94***, ASTM International, West Conshohocken, Pennsylvania.

MUSTARD AGENT TRIAL BURN PLAN

FOR THE

LIQUID INCINERATORS

APPENDIX A

LIC QUALITY ASSURANCE PROJECT PLAN

Revision 1

April 6, 2006

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

TOOELE CHEMICAL AGENT DISPOSAL FACILITY

Facility EPA ID Number: UT5210090002

Prepared for: Tooele Chemical Agent Disposal Facility
11600 Stark Road
Tooele, UT 84074

Revision No.: 1

Date: April 6, 2006

1.0 TITLE PAGE

1.1 Project Title:

MUSTARD AGENT TRIAL BURN FOR THE
LIQUID INCINERATORS
QUALITY ASSURANCE PROJECT PLAN

1.2 Expected Trial Burn Dates: September 2006

1.3 Project Approvals:

Thaddeus Ryba, CMA Project Manager

Date

Gary McCloskey, EG&G DMI General Manager

Date

**Craig M. Young, Ph.D., EG&G DMI,
Project Specialist**

Date

Subcontractor Quality Assurance Director

Date

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LIST OF ACRONYMS AND ABBREVIATIONS

ACA	Absolute Calibration Audit
ACAMS	Automatic Continuous Air Monitoring System
ACS	Agent Collection System
ADAFC	ACAMS Dilution Air Flow Controller
AQS	Agent Quantification System
ASTM	American Society for Testing and Materials
ATB	Agent Trial Burn
AWFCO	Automatic Waste Feed Cutoff
Brine	Wet Scrubber Recirculation Brine
CAA	Clean Air Act
CAL	Chemical Assessment Laboratory
CAR	Contract Administrative Representative
CC	Correlation Coefficient
CCC	Calibration Check Compound
CCV	Continuing Calibration Verification
CEMS	Continuous Emission Monitoring System
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chain-of-Custody
CPT	Comprehensive Performance Test
CVAAS	Cold Vapor Atomic Absorption Spectroscopy
DAAMS	Depot Area Air Monitoring System
DAQ	State of Utah, Department of Environmental Quality, Division of Air Quality
DDAFC	DAAMS Dilution Air Flow Controller
DEQ	State of Utah Department of Environmental Quality
DCD	Deseret Chemical Depot
Decon	Spent Decontamination Solution
DFS	Deactivation Furnace System
DI	Deionized (as in deionized water)
DQO	Data Quality Objective
DRE	Destruction and Removal Efficiency
DSHW	State of Utah, Department of Environmental Quality, Division of Solid and Hazardous Waste
EG&G	EG&G Defense Materials, Inc.
EPA	U.S. Environmental Protection Agency
ER	Emission Rate

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

GC	Gas Chromatograph
GC/FID	Gas Chromatograph/Flame Ionization Detector
GC/FPD	Gas Chromatograph/Flame Photometric Detector
GC/MS	Gas Chromatograph/Mass Spectrometer
HHRA	Human Health Risk Assessment
HRGC/HRMS	High Resolution Gas Chromatograph/High Resolution Mass Spectrometer
HWC	Hazardous Waste Combustor
IC	Ion Chromatograph
ICP	Inductively Coupled Plasma
ICP/MS	Inductively Coupled Plasma/Mass Spectrometer
ICV	Initial Calibration Verification
ID	Induced Draft
IDLH	Immediately Dangerous to Life or Health
LCS	Laboratory Control Sample
LIC	Liquid Incinerator
LOP	Laboratory Operating Procedure
LOQ	Limit of Quantitation
MACT	Maximum Achievable Control Technology
MDL	Method Detection Limit
MPF	Metal Parts Furnace
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NIST	National Institute for Standards and Technology
NVTOC	Non-Volatile Total Organic Compounds
PAS	Pollution Abatement System
PCC	Primary Combustion Chamber
PDARS	Process Data Acquisition and Recording System
PIC	Product of Incomplete Combustion
PM	Particulate Matter
POHC	Principal Organic Hazardous Constituent
PQL	Practical Quantitation Limit
PST	Performance Specification Test
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QP	Quality Plant Sample

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

%R	Percent Recovery
RATA	Relative Accuracy Test Audit
RCRA	Resource Conservation and Recovery Act
RF	Response Factor
RPD	Relative Percent Difference
RRF	Relative Response Factor
RSD	Relative Standard Deviation
SCC	Secondary Combustion Chamber
SEL	Source Emission Limit
SMVOC	Sampling Method for Volatile Organic Compounds
SOP	Standard Operating Procedure
SPCC	System Performance Check Compound
STC	Sampling Team Coordinator
STEL	Short Term Exposure Limit
SVOC	Semi-Volatile Organic Compound
SVTOC	Semi-Volatile Total Organic Compounds
SW-846	Test Methods for Evaluating Solid Waste, 3rd Edition including Update III, USEPA, SW-846, December 1996.
TCLP	Toxicity Characteristic Leaching Procedure
TEF	Toxic Equivalency Factor
TEG	Total Exhaust Gas
TE-LOP	Tooele Laboratory Operating Procedure
TEQ	Toxic Equivalent Concentration
THC	Total Hydrocarbons
TIC	Tentatively Identified Compound
TOC	Total Organic Compound
TOCDF	Tooele Chemical Agent Disposal Facility
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
VTOC	Volatile Total Organic Compounds

LIST OF UNITS AND MEASUREMENTS

acfm	actual cubic feet per minute
amu	atomic mass unit
cfm	cubic feet per minute
°C	degree centigrade
°F	degree Fahrenheit
dscf	dry standard cubic foot
dscfm	dry standard cubic feet per minute
dscm	dry standard cubic meter
dsL	dry standard liter
ft	foot
g	gram
g/sec	grams per second
gal	gallon
gpm	gallons per minute
gr/dscf	grains per dry standard cubic foot (1 atmosphere, 68 °F)
ΔH	average pressure differential across orifice meter
inHg	inches of mercury
inWC	inches of water column
kg	kilogram
L	liter
L/min	liters per minute
μg	microgram
m^3	cubic meter
mg	milligram
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
min	minute
mL	milliliter
mL/min	milliliters per minute
<u>N</u>	Normal
ng	nanogram
ppb	parts per billion
ppm	parts per million
ppmdv	parts per million on a dry volume basis
lb/hr	pounds per hour
psig	pounds per square inch gauge
ΔP	pitot velocity pressure
Wt%	weight percent
Y_c	dry gas meter calibration factor

LIST OF CHEMICAL SYMBOLS AND FORMULAS

Agent GB	Sarin or O-Isopropyl methyl phosphonofluoridate
Agent VX	O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothiolate
Al	aluminum
Ag	silver
As	arsenic
B	boron
Ba	barium
BFB	4-bromofluorobenzene
Be	beryllium
Cd	cadmium
Cl ⁻	chloride
Cl ₂	chlorine
CO ₂	carbon dioxide
CO	carbon monoxide
Co	cobalt
Cr	chromium
Cu	copper
DFTPP	decafluorotriphenylphosphine
HNO ₃	nitric acid
Hg	mercury
HCl	hydrogen chloride
HF	hydrogen fluoride
H ₂ O ₂	hydrogen peroxide
KMnO ₄	potassium permanganate
Mn	manganese
Mustard Agent	<i>bis</i> (2-chloroethyl)sulfide
NaOCl	sodium hypochlorite
NaOH	sodium hydroxide
Na ₂ S ₂ O ₃	sodium thiosulfate
H ₂ SO ₄	sulfuric acid
Ni	nickel
O ₂	oxygen
P	phosphorus
Pb	lead
PCBs	polychlorinated biphenyls
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran

LIST OF CHEMICAL SYMBOLS AND FORMULAS (continued)

PFTBA	perfluorotributylamine
PFK	perfluorokerosene
Q	1,2- <i>bis</i> (2-chloroethylthio)ethane
Sb	antimony
Se	selenium
Sn	tin
SO ₂	sulfur dioxide
T	<i>bis</i> [2-(2-chloroethylthio)ethyl] ether
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
Tl	thallium
V	vanadium
Zn	zinc

3.0 PROJECT DESCRIPTION

The Tooele Chemical Agent Disposal Facility (TOCDF) was designed and built for the U.S. Army as a hazardous waste incinerator facility, for the destruction of the chemical munitions stockpile at the Deseret Chemical Depot (DCD), which is 20 miles south of Tooele, Utah. The incinerator system is designed to dispose of chemical agents (GB, VX, H-series mustard), drained munitions, contaminated refuse, bulk containers, liquid wastes, explosives, and propellant components. The TOCDF operates under a Resource Conservation and Recovery Act (RCRA) permit issued pursuant to delegation by the State of Utah, Department of Environmental Quality (DEQ), Division of Solid and Hazardous Waste (DSHW) under the Utah Administrative Code, Section 315. The TOCDF also operates under a Title V permit from the State of Utah, Department of Environmental Quality, DEQ, Division of Air Quality (DAQ). Emissions from the TOCDF incinerators are regulated under the joint authority of the Clean Air Act (CAA) and RCRA.

The TOCDF facility has four incinerator systems, two Liquid Incinerators (LIC1 and LIC2), the Metal Parts Furnace (MPF), and the Deactivation Furnace System (DFS). The systems are designed to meet the Hazardous Waste Combustor (HWC) Maximum Achievable Control Technology (MACT) regulation performance requirements, which are found in Title 40 of the Code of Federal Regulations, Part 63, Subpart EEE (40 CFR 60, EEE).

The TOCDF Environmental Protection Agency (EPA) identification number is UT5210090002. Under the requirements of the TOCDF RCRA Permit, the incinerator system must demonstrate an ability to effectively treat any hazardous waste such that human health and the environment are protected, and the MACT rule has set the performance standards that incinerators must meet. Agent Trial Burns (ATBs) are conducted at the TOCDF to demonstrate compliance with the applicable regulations. The LIC Mustard ATB is also being conducted as a Comprehensive Performance Test (CPT) to show compliance with the HWC MACT regulations. This test will collect a set of samples to meet the requirements of an ATB and CPT, but will be referred to as the ATB in the LIC Mustard ATB Plan. These ATBs are a combined test to demonstrate compliance with performance standards and a RCRA trial burn to collect data to update the DCD Human Health Risk Assessment (HHRA). This Quality Assurance Project Plan (QAPP) describes the sampling and analytical activities that will be performed by the sampling subcontractor and laboratory during the LIC Mustard ATB. The QAPP was developed using methods from SW-846 (1) and guidance from EPA Region 6 (2).

EG&G Defense Materials, Inc. (EG&G), is responsible for operating TOCDF and conducting the ATBs. EG&G is the principal data user and decision-maker for the LIC Mustard ATB, but will subcontract the sampling and analysis portions of this ATB. This subcontracted support will include the performance of gas sampling, collection of selected process samples, transportation of samples to the laboratory, sample analyses, Quality Assurance/Quality Control (QA/QC) associated with these tasks, and reporting of the results. The subcontractor will provide in-

process approvals with final acceptance and approval by EG&G. EG&G will be responsible for the collection of certain monitoring information, the collection and analysis of mustard agent feed samples, the collection of system operating data, and preparation of the final report.

The exhaust gas will be tested for the following substances during the LIC Mustard ATB:

- Mustard agent;
- Oxygen (O₂), carbon monoxide (CO), and carbon dioxide (CO₂);
- Particulate matter (PM);
- Hydrogen fluoride (HF), hydrogen chloride (HCl), and chlorine (Cl₂) also referred to as the halogens;
- Sulfur dioxide (SO₂);
- Nitrogen oxides (NO_x);
- Metals;
- Volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs);
- Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDDs/PCDFs);
- Volatile Total Organic Compounds (VTOC), Semi-Volatile Total Organic Compounds (SVTOC), Non-Volatile Total Organic Compounds (NVTOC), and Total Hydrocarbons (THC).

The Principle Organic Hazardous Constituent (POHC) will be *bis*(2-chloroethyl) sulfide, which will be determined by specific TOCDF monitors developed for this purpose. A second POHC added to the Secondary Combustion Chamber (SCC) will be chlorobenzene for the CPT portion of the trial burn. The agent monitoring data will be used to verify that the LIC can demonstrate 99.9999 percent Destruction and Removal Efficiency (% DRE) or greater for mustard agent. The VOC analyses will demonstrate a DRE for chlorobenzene of $\geq 99.99\%$. Identification of Products of Incomplete Combustion (PICs) will be performed using SW-846, Methods 5041A/8260B and 8270C (1), for all performance runs. The PCDDs/PCDFs are a special class of PICs and will be sampled using Method 0023A (1) and analyzed using Method 8290 (1).

The exhaust gas will be analyzed for the elements used in the HHRA, which are: aluminum (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), selenium (Se), silver (Ag), thallium (Tl), tin (Sn), vanadium (V), and zinc (Zn).

Samples of the agent feed, wet scrubber recirculation brine (Brine), spent decontamination solution (Decon), sodium hydroxide (NaOH) makeup, and process water will be analyzed for VOCs, SVOCs, and HHRA metals. Samples of the slag will be taken after this ATB. The slag will be analyzed for total HHRA metals and evaluated using the Toxicity Characteristic Leaching Procedure (TCLP), Method 1311 (1). The TCLP extract will be analyzed for the TCLP metals. Samples of the slag, Decon, and Brine will be analyzed for agent before sample transport.

The LIC Mustard ATB Plan is designed to demonstrate the DRE, under normal operating conditions, that will apply during the actual agent munitions demilitarization campaigns. Scheduling for the project is found in each ATB plan and will be updated as necessary. An example of a daily sample run schedule is in Section 6.0. Data Quality Objectives (DQOs) for each method are found in Annex A to this QAPP. Individual project and quality records are identified in this QAPP. Examples of the Calibration Data Sheets, Isokinetic Run Sheets, and Chain-of-Custody (COC) Records are found in Annex B. Annex C contains resumes of the key individuals for this project and the DAQ and DSHW will be updated when any changes occur.

4.0 PROJECT ORGANIZATION

The LIC Mustard ATB organization is summarized in Figure A-4-1. This organization has three groups that work together for the successful completion of this ATB. One group is the EG&G organization, the second is the Battelle Chemical Assessment Laboratory (CAL), and the third is the sampling and analysis subcontractor. This project management structure anticipates the direct, personal responsibility for each task and provides the mechanism for review and corrective action. The direct supervisory line of responsibility also provides for flexibility and timely action to correct problems. The EG&G Contract Administrative Representative (CAR) will interface with the subcontractor organization and the CAL. The EG&G Test Director has the overall responsibility for this ATB, and as such, is the point of contact between EG&G Operations and the ATB organization. Annex C contains copies of the resumes of the key individuals involved in the LIC Mustard ATB. If any subcontractors for the LIC Mustard ATB change, resumes for the new subcontractor's key individuals will be provided to DAQ and DSHW.

4.1 TEST DIRECTOR

The Test Director is an employee of EG&G and has the overall responsibility for the conduct of the LIC Mustard ATB. The duties of the Test Director include:

- Ensuring that the feed is prepared for the ATB.
- Establishing the system operating parameters as described in the ATB plan.
- Determining when Operations is ready to begin the performance run.
- Notifying the CAR to have the sampling subcontractor begin sampling.
- Determining whether the performance run is acceptable from an EG&G perspective.

4.2 CONTRACT ADMINISTRATIVE REPRESENTATIVE

The CAR is an EG&G employee and has the responsibility of ensuring that the sampling subcontractor performs as directed by the QAPP and the sampling contract. The CAR coordinates the activities of EG&G, monitoring personnel, CAL personnel, and the sampling subcontractor. In addition, he will coordinate the information to be provided in the final LIC Mustard ATB Report.

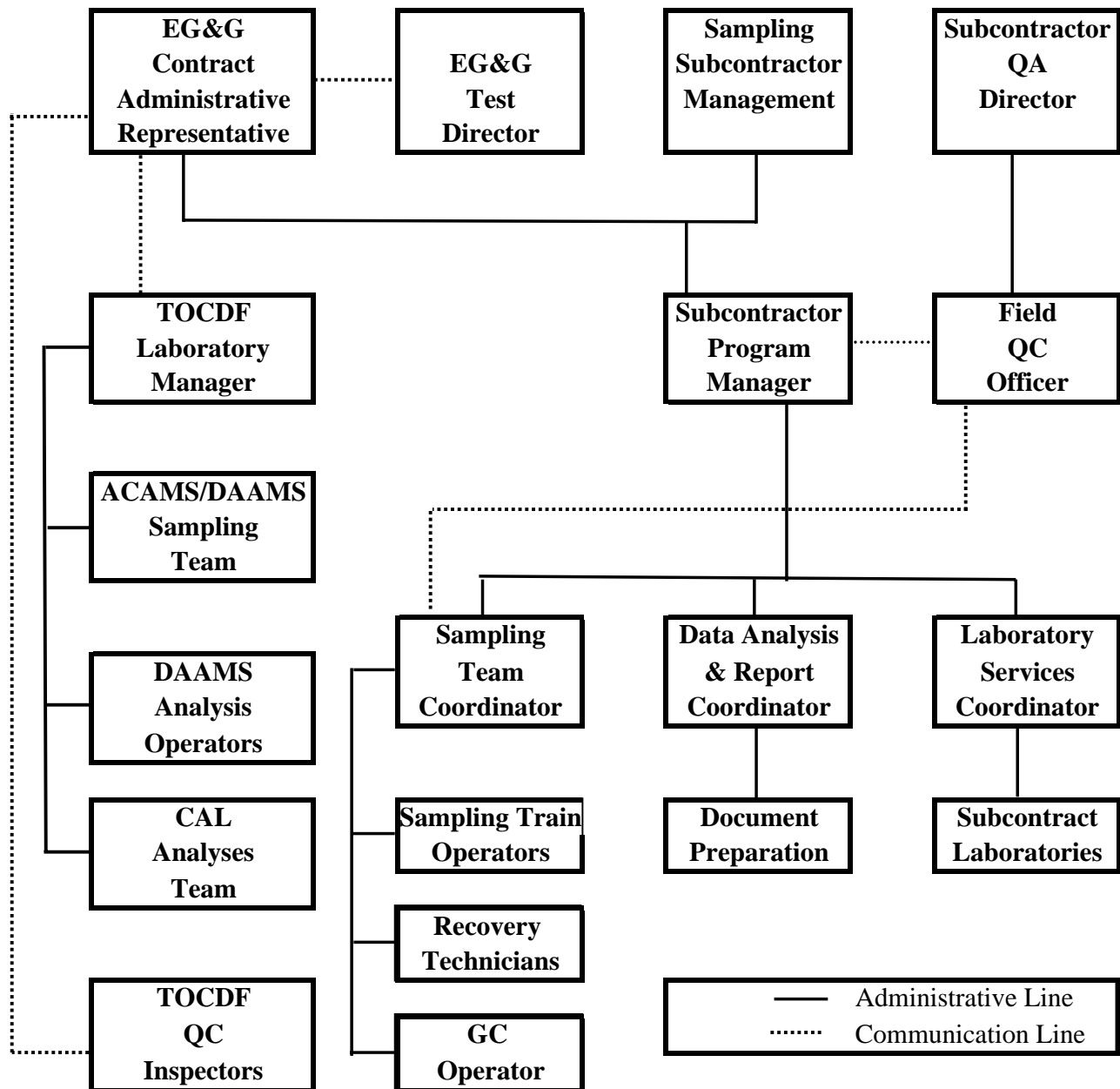


FIGURE A-4-1. LIC MUSTARD ATB ORGANIZATION CHART

4.3 TOCDF LABORATORY MANAGER

The TOCDF Laboratory Manager is a Battelle employee who manages both the Monitoring Group and the CAL. The Monitoring Group has the responsibility for the Automatic Continuous Agent Monitoring System (ACAMS) Sampling Team, the Depot Area Air Monitoring System (DAAMS) Sampling Team, and the Continuous Emission Monitoring System (CEMS) Monitoring Team. The CAL has the responsibility for the DAAMS analyses, mustard agent analyses, and the Battelle QC Inspectors. The Laboratory Manager is specifically responsible for:

- Tracking samples through the CAL.
- Archiving the analytical data generated by the CAL.
- Providing the QC performed in support of the DAAMS and mustard agent analyses.

4.4 SUBCONTRACTOR PROGRAM MANAGER

The Subcontractor Program Manager is an employee of the subcontracted sampling firm. The Subcontractor Program Manager is responsible for:

- Committing the subcontractor resources to the project.
- Resolving problems if they occur.
- Ensuring that the subcontracting firm complies with the QAPP and the contract with EG&G.
- Providing the detailed planning of the sample collection efforts in coordination with the CAR.

4.5 SUBCONTRACTOR QUALITY ASSURANCE DIRECTOR

The QA Director is a sampling subcontractor employee who manages the QA/QC for the project through the activities of the Field QC Officer. The QA Director reports to the Subcontractor Management and is responsible for:

- Overseeing the overall QA/QC for the subcontractor part of the LIC Mustard ATB.
- Assisting in the development of the data evaluation report for the ATB.

4.6 FIELD QUALITY CONTROL OFFICER

The Field QC Officer will report to the Subcontractor Program Manager and is responsible for:

- Enforcing the protocols of the QAPP.
- Observing all on-site activities to ensure that the QAPP was followed.
- Coordinating with the Sampling Team Coordinator (STC) on observation of field sample collecting.

4.7 SAMPLING TEAM COORDINATOR

The STC is a sampling subcontractor employee who is responsible for:

- Managing on-site work by subcontractor employees.
- Completing the data collection for lab analyses, gas sampling data, emission calculations, and results reporting.
- Delivering samples to the laboratory.
- Overseeing the required sampling.
- Directly supervising the gas sampling teams, providing:
 - Equipment;
 - Transportation;
 - Set up;
 - Calibration;
 - Sample train operations;
 - Pre- and post-test leak checks;
 - Isokinetic checks; and
 - Gas sample recovery.

The CAR will be available to coordinate with the STC, including discussing changes in any sampling or analytical procedures.

4.8 SUBCONTRACTOR LABORATORY SERVICES COORDINATOR

The Laboratory Services Coordinator is a sampling subcontractor employee who will interface with the subcontractor laboratories and oversee all subcontracted analytical activities to ensure that the samples are analyzed according to the methods and procedures specified in the QAPP. In addition, the Laboratory Services Coordinator is responsible for:

- Coordinating the field sampling documentation and sample analysis request forms.
- Preparing COC Forms.
- Overseeing the preparation of the Data Validation Report on the QA/QC activities of the subcontract laboratories.
- Preparing the analytical data for inclusion in the final ATB report.

4.9 SUBCONTRACTOR SAMPLING TEAM MEMBERS

These team members are sampling contractor employees. Each team will include a team leader and technician. The leader will be responsible for operation of the testing equipment, QA/QC, and record keeping for the assigned train. The team leader reports any irregularities to the STC, and the STC will report any sampling problems to the EG&G CAR and the Subcontractor Program Manager.

4.10 SUBCONTRACT LABORATORIES

The subcontracted laboratories will verify and document that the incoming field samples match the COC and analysis request forms. They will be responsible for tracking the samples through the laboratory and performing the appropriate tasks to meet QC requirements outlined in the QAPP. Additionally, the laboratories will be responsible for archiving the laboratory data that they generate.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL OBJECTIVES

The overall objective of the measurement data for the LIC Mustard ATB is to demonstrate compliance with the RCRA Permit, Title V Air Permit, the MACT emission limits and demonstrate at least a 99.9999 % DRE for *bis*(2-chloroethyl) sulfide. To assess the quality of the data, a series of DQOs have been set for each method used for the analysis of samples collected during this ATB. The DQOs, summarized in Annex A, will be used to evaluate the data generated during the ATB. The data quality indicators produced to meet the DQOs will be evaluated against the data acceptance criteria identified in Annex A. These criteria identify the target precision and accuracy limits that are used to assess the data quality. Annex A was developed using the criteria from the Region 6 guidance (2), EPA QA/G-5 (3), the QA/QC Handbook (4), and SW-846 (1).

The Laboratory Services Coordinator and the Subcontractor QA Director will review the field and analytical data obtained from this ATB. A complete assessment of the data quality indicators will be included in the LIC Mustard ATB Report. The data quality will be discussed with regard to the planned data acceptance criteria and the overall project objectives. Data that are determined to be outside the QC limits will be evaluated relative to the overall project objectives to determine their impact on defining the system's performance. A discussion of this evaluation will be included in the ATB report.

Several procedures will be used for monitoring the precision and accuracy DQOs of the analytical program. These procedures include:

- Sampling and analytical activities that will follow standard referenced procedures whenever possible.
- Calibration standards, internal standards, laboratory control standards (LCS), and surrogate compounds that will be of high-purity, commercially-available materials.
- Analytical instruments that will be calibrated per the reference method requirements prior to sample analysis in order to demonstrate that accurate performance levels are being met.
- Data precision and accuracy that will be assessed by evaluating the results from the analysis of internal standards, surrogate compounds, laboratory blanks, calibration check standards, reagent blanks, method blanks, field and trip blanks, duplicate samples, and matrix or surrogate spiked samples.

Sections 6.0 and 10.0 describe the project-specific QC sample types that will be analyzed and list the sampling and analytical methods to which they will be applied.

When analytical QC procedures reveal that a measurement error has exceeded the target criterion, the source of the deviation will be identified, and corrective action will be taken as described in Annex A. If data fall outside the acceptable range of precision and accuracy, even

after corrective action has been taken, those data points will be flagged and discussed specifically in the data validation report. Alternative procedures (either sampling or analytical) will be considered and recommended to the CAR when necessary. Any changes or additions will be submitted to the DAQ and DSHW for approval as soon as the need is identified.

5.1 EVALUATION OF PRECISION

Estimates of precision are different for each method, and method-specific precision DQOs are listed by method in Annex A. Estimates of variability levels for replicate measurements of the same parameters are expressed in terms of Relative Percent Difference (RPD) for duplicate samples and as Relative Standard Deviation (RSD) when three or more data points are being compared. Section 13.1 discusses how the estimates of method precision will be calculated.

Some analyses require the evaluation of a larger data set, in which case, precision will be reported as RSD. Examples of large data sets that will be used to evaluate precision include surrogate spikes for VOC and SVOC determinations. When the analytical results approach the detection limit, precision often is affected adversely because of the enhanced uncertainty of determinations at the lower end of the method applicability. For those determinations near the method detection limit, the precision estimates that are outside the target DQOs will be flagged as estimated measurements. In cases where duplicates are performed, and one result is less than the Practical Quantitation Limit (PQL), the average will be calculated using the PQL; the result reported will be flagged to explain that the precision was not calculated. Precision data will be calculated and presented in the data validation report.

Calculation of the precision for each analysis will be based on different criteria outlined in the QA/QC Handbook (4) and the analytical methods. The precision for the halogen samples will be determined by the RPD calculated from the analysis of the Matrix Spikes and Matrix Spike Duplicates (MS/MSD). The MS/MSD will be used because the field samples have a history of very low concentrations. The precision of the Sampling Method for Volatile Organic Compound (SMVOC) samples will be based on the RSD calculated from the analysis of the LCS. The precision of the semi-volatile compounds will be based on the RPD from the analysis of the LCS. The results of the analysis of spiked samples will be used because of the historically-low concentrations found in field samples. Precision for the metals emission samples will be based on the RPD of the LCS and duplicate analyses of one emission sample. Precision data for metals in the process samples will be based on MS/MSD and duplicate samples. The estimate for precision for the CEMS data will be as required by the CEMS Monitoring Plan in Attachment 20 to the TOCDF permit (5) for the LIC CEMS and by the 40 CFR 60, Appendix A methods used for the sampling subcontractor CEMS.

5.2 EVALUATION OF ACCURACY

Accuracy will be expressed as a percent recovery (%R) for each method. The standard used to measure the %R is method dependent (see tables in Annex A). Additional audit samples may be submitted by DSHW and will act as an independent measure of accuracy. Analysis of an LCS will be assessed as a measure of accuracy; matrix effects on accuracy will be assessed using MS/MSD. A combination of LCS and MS/MSD analyses will be used to evaluate the accuracy of most analysis methods. An evaluation of the accuracy of organic compound analyses that use a gas chromatograph/mass spectrometer (GC/MS) will include the recovery of surrogate compounds spiked into each sample. Section 13.0 provides the accuracy calculations. Accuracy data will be presented in the data validation report.

An assessment of accuracy on the SMVOC will include an evaluation of the analysis of the Tenax® traps and the Anasorb®-747 traps analyzed separately to determine possible compound breakthrough to the Anasorb®-747 portion of the sampling train. The analysis of an Anasorb®-747 trap should indicate less than 30 percent of the compound concentration that is collected by the front two Tenax® traps. Breakthrough of the compound to the Anasorb®-747 above this level may indicate a loss of the collection efficiency and result in a negative bias in the analytical result. This criterion does not apply when less than 75 nanograms (ng) are detected on the Anasorb®-747 tube.

Calculation of the accuracy for each analysis will be based on different criteria taken from the QA/QC Handbook (4) and the analytical methods. Determinations of accuracy calculations will be as follows:

- For halogen samples, by the %R calculated from the analysis of the MS/MSD.
- For SMVOC samples, based on the %R calculated from the analysis of the LCS.
- For SVOCs, based on the %R from the analysis of the LCS.
- For metals emission samples, based on the analysis of the LCS.
- For PCDD/PCDF analyses, taken from the LCS data.
- For the CEMS, as directed by Attachment 20 (5). (The TOCDF CEMS are certified on an annual basis. This certification involves the measurement of calibration drift, response time, calibration error, and accuracy as measured against a known standard gas.)

5.3 EVALUATION OF COMPLETENESS

Data completeness represents the percentage of valid data collected from a measurement system as compared to the total amount expected to be obtained under optimal or normal conditions. The completeness DQO for the LIC Mustard ATB will be to obtain representative results for all analytical parameters while operating the unit at the desired test specifications for a total of three

test runs. The completeness DQO (100 percent completeness) will be met if valid test runs are obtained. Samples resulting from runs that are judged to be invalid based on field indicators of incinerator performance (or aborted runs) will not be submitted to the laboratory for analysis and are not considered to be a part of the sample completeness objective. Sampling runs will be repeated until three runs for each ATB test condition are completed. The impact of any occurrence of sample loss will be assessed against the objective of obtaining valid runs and will be discussed in the LIC Mustard ATB Report.

5.4 DETECTION AND REPORTING LIMITS

The laboratories will prepare Method Detection Limit (MDL) and PQLs for parameters to be analyzed for the ATB using the laboratory's standard operating procedures and the analytical methods referenced in this document. These limits will be compared to the actual analytical results in the final report. Analytes not detected in the analyses will be reported as less than (<) the PQL. Analytes detected with a concentration between the MDL and the PQL will be qualified as an estimate and reported. The laboratory conducting the analysis will determine the MDLs and PQLs. The PQLs for the ATB parameters are included in Annex A.

5.5 REPRESENTATIVENESS AND COMPARABILITY

Representativeness is defined as "the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, process condition, or an environmental condition." Comparability is defined as "expressing the confidence with which one data set can be compared to another" as discussed in EPA QA/G-5 (3).

The usefulness of the data is contingent upon meeting the criteria for representativeness and comparability. Wherever possible, reference methods and standard sampling procedures will be used. The representativeness DQO is that all measurements be representative of the media and operation being evaluated. The detailed requirements for each parameter given in their respective methods will be followed to ensure representative sampling.

The comparability DQO is that all data resulting from sampling and analysis be comparable with other representative measurements made by the sampling subcontractor or another organization on this or similar processes operating under similar conditions. The use of published sampling and analytical methods and standard reporting units will aid in ensuring the comparability of the data.

6.0 SAMPLING AND MONITORING PROCEDURES

The LIC must demonstrate an ability to effectively incinerate the mustard agent removed from bulk containers and munitions such that human health and the environment are protected. The HWC MACT Limits establish the criteria against which applications for permits must be measured. The LIC Mustard ATB will demonstrate that the LIC operating parameters meet the required performance standards. The data obtained during this ATB will demonstrate compliance with these regulations. The ATB will be considered successful when identified analysis and DRE fall within parameters stated in this QAPP.

This section describes the process and exhaust gas sampling procedures to be performed and the equipment to be used during the LIC Mustard ATB. The sample types, sampling locations, and sample collection procedures will also be discussed. The sampling subcontractor will utilize EPA-approved sampling methods, if available, for the selected analytes. Any proposed modifications to approved methods or procedures will be presented to the DAQ and DSHW for approval prior to implementation and will be documented in the final report.

Standard sampling equipment that meets EPA guidance will be used to collect the exhaust gas and process samples. An independent peer review is not included as part of this scope of work. A final readiness review will be performed by the subcontractor to ensure that the subcontractor organization has the appropriate manpower, equipment, and training in place before start of this ATB.

6.1 PRE-SAMPLING ACTIVITIES

Many pre-sampling activities need to be completed before sampling can begin. These tasks include equipment calibration, glassware preparation, sample media preparation, team meetings, equipment packing and shipment, equipment setup, and finalization of all the miscellaneous details leading up to the coordinated initiation of the sampling program.

6.1.1 Calibration of Process Monitoring Equipment

Calibration of the process control instruments is required on a regular basis. The calibration status of the LIC process control instruments at the time of the ATB will be included in the LIC Mustard ATB Report. The calibration frequency for the process control instruments is summarized in Table 2-3 of the LIC Mustard ATB plan.

6.1.2 Sampling Equipment Calibration

Section 8.0 discusses the calibration procedures for the sampling equipment.

6.1.3 Glassware Preparation

The only consumables used in the LIC Mustard ATB sampling will be the sample bottles and the reagents used in the impingers and for recovery of the samples. The sample containers will be purchased pre-cleaned to meet EPA criteria for clean containers, per specific container type and purpose; a certificate will be provided with the containers to document compliance with these specifications. Sample train glassware and sample containers require specialized cleaning to avoid sample contamination from the collection containers or sampling equipment. Cleaning procedures for the sample train glassware are summarized below:

- Method 0010 and Method 0050 glassware and containers: hot water rinse; hot, soapy water wash; water rinse; deionized (DI) water rinse; acetone rinse; and air dry.
- Method 0023A glassware and containers: hot, soapy water wash; water rinse; DI water rinse; 400 °C heating for two hours; methylene chloride rinse; toluene rinse; and rinse with acetone and methylene chloride.
- Method 29 glassware and containers: hot water rinse; hot, soapy water wash; water rinse; 10 percent nitric acid soak; DI water rinse; acetone rinse; and air dry.
- Method 0031 and Method 0040 glassware and containers: soap and water wash, DI water rinse, and oven dry at 150 °C for two hours. (SMVOC tubes prepared by Method 0031.)

6.1.4 Sample Media Preparation

Reagents used in the laboratory are normally of analytical reagent grade, or higher, purity. Reagents will be labeled with the date received and the date opened. Reagent purity will be checked by collection of the appropriate blanks. All filters will be desiccated and properly tare-weighted prior to use.

The SMVOC tubes will be supplied to the sampling subcontractor by the laboratory just prior to the field effort. Sorbents used for the Method 0031 sampling will be prepared using two different methods. The Tenax® tubes will be conditioned at 225 °C ($\pm 10^\circ\text{C}$) with a ≥ 100 -mL/min flow of ultra-high-purity helium or nitrogen. The Anasorb®-747 tubes will be conditioned at 300 °C ($\pm 10^\circ\text{C}$) with a ≥ 100 -mL/min flow of ultra-high-purity helium or

nitrogen. Tubes will then be placed into 25- by 150-mm, clean culture tubes while still hot. Each batch of SMVOC tubes will be verified clean by a GC/MS analysis. A blank Tenax® cartridge will be thermally desorbed into the GC/MS. The Tenax® will not be considered acceptable if more than 50 ng of any priority pollutant is found. An Anasorb®-747 cartridge will be analyzed by GC/MS and evaluated using the same criteria.

The XAD-2® traps and filters will be supplied to the sampling subcontractor by the laboratory just prior to the field effort. The XAD-2® resin traps shall be cleaned and conditioned as directed in the methods. An analysis of each batch of XAD-2® resin will be provided before use as a QA/QC step. The resin used for the PCDD/PCDF sampling will be analyzed using a High Resolution Gas Chromatograph/High Resolution Mass Spectrometer (HRGC/HRMS) to ensure that the resin is contaminant free.

6.1.5 Additional Pre-Sampling Activities

Prior to mobilization of the field program, a sample team meeting will be held to designate responsibilities to each team member for the LIC Mustard ATB. Assignments will be made based on individual experience and the relative importance of the assigned task. Site setup will be the final pre-sampling activity. This task involves positioning the sampling equipment in the sampling area. During setup, preliminary measurements will be taken to determine exhaust gas moisture and flow rate. Preliminary exhaust gas moisture will be determined in accordance with EPA Method 4 (6), and preliminary flow rate measurements will be conducted using Methods 1 and 2 (6). These data will be used to calculate the appropriate nozzle size and sample flow rate to be used to accomplish isokinetic sampling.

6.2 FIELD QUALITY CONTROL ACTIVITIES

The QC checks for the process data collection and sampling aspects of this program will include but are not limited to:

- Using standardized forms and field notebooks to ensure completeness, traceability, and comparability of the process information and samples collected.
- Field checking standardized forms to ensure accuracy and completeness.
- Strictly adhering to the sample traceability procedures (i.e., COC) outlined in Section 7.2.1.
- Submitting field-biased blanks.
- Leak checking sample trains before and during port change and after sample collection.

6.2.1 Reagent Blanks

Reagent blanks will be prepared by collecting reagents used in the sampling and recovery of the exhaust gas samples. Reagent blanks are defined as samples of the reagent source water, solvents, solutions, and other media used for sample collection. Reagent blank samples of 0.1 Normal (N) sulfuric acid (H_2SO_4), 0.1 N NaOH, acetone probe rinse solvent, and the particulate filter will be collected for the Method 5/0050 trains. The following reagent blank samples will be collected for the Method 29 train: 0.1 N nitric acid (HNO_3) probe rinse solution, particulate filter, 5 percent HNO_3 and 10 percent hydrogen peroxide (H_2O_2) impinger solution, 4 percent potassium permanganate (KMnO_4) and 10 percent H_2SO_4 , and 8 N HCl.

The following reagent blanks will be collected for the Method 0010 trains: acetone, methylene chloride, and toluene solvent rinses (toluene collected for the Method 0023A train only), particulate filter, and DI impinger water. Each reagent blank will be analyzed for the same analytical parameters as the actual LIC Mustard ATB samples. The results from the analyses of these blanks will be used to demonstrate that these solvents, solutions, and filters are not potential sources of background contamination for samples requiring these sampling media during collection.

6.2.2 Field Blanks

Field blank samples will be collected during the LIC Mustard ATB to provide a QC check on sample handling. Field blanks contain all the reagents used during the sample collection process. The field blank will be a sampling train assembled in the field, leak checked, let stand for the sample time, and then recovered as other trains. Field biased blanks of reagents and collection media (e.g., DI water, filters, impinger solutions, SMVOC tubes, XAD® resin traps) will be placed in appropriately-cleaned and sized sample containers in the field and handled in the same way as actual field samples. Samples from the field blanks are analyzed by the same methods as the samples. The DAQ and DSHW personnel will be notified when the field blanks will be collected to allow them the opportunity to observe collection.

6.2.3 Trip Blanks

Trip blanks will be used to check for contamination resulting from the shipping and transport of the samples to the laboratory. Trip blanks will consist of a set of clean, sealed SMVOC resin tubes and a pair of Volatile Organic Analysis (VOA) vials filled with ASTM Type II DI water. These tubes and vials are transported from the analytical laboratory to the field site and returned to the laboratory for storage and analysis along with the field test samples. The trip blank data will demonstrate that the samples are not exposed to fugitive contamination during storage and transport to their final laboratory destination. Trip blanks are analyzed for the same analytical parameters as the actual test samples. Trip blanks will generally be considered to demonstrate

good quality of background if the compound concentrations detected are less than the lowest calibration standard, as specified in the QA/QC Handbook (4), with the exception of low levels of common laboratory contaminants and resin degradation products.

6.2.4 Field Duplicates

Duplicate samples of the neat agent, Brine, and Decon will be collected during one performance run as a QC step.

6.3 EXHAUST GAS SAMPLING

The exhaust gas sampling will be conducted by EG&G and a subcontractor. The sampling will take place in the duct between the LIC induced draft fan and the common stack (LIC Duct). Monitoring of mustard agent and the LIC CEMS operation will be conducted by EG&G. The sampling subcontractor will sample for PM, HF, HCl, Cl₂, metals, VOCs, VTOC, SVOCs, SVTOC, NVTOC, and PCDDs/PCDFs. Monitoring for CO, O₂, CO₂, SO₂, NO_x, and THC will be done with CEMS operated by the sampling subcontractor. An exhaust gas molecular weight will be calculated from the subcontractor CEMS data.

Sampling will begin when the incinerator has reached steady-state operations on waste feed, and a run will not be started after 2:00 p.m. The Test Director or a designated representative will authorize the STC to begin sampling. Sampling will be stopped if the waste feed is stopped. To restart sampling, the agent feed will be burned for 15 minutes, and if operating parameters are steady, sampling will be restarted.

Sampling train problems will be analyzed on-site by the STC and the Test Director. If it can be shown that the samples collected are not significantly biased and the results are valid, the run will continue. If the decision is made to abort a performance run, the entire set of samples collected for that run will not be analyzed. If any corrective action is required during the field-sampling portion of a program, these actions will be reported to the STC prior to the sampling crew demobilizing from the field. If the STC determines that a run should be repeated, he makes the determination at that point and communicates this requirement to the Test Director. These problems and their resolution will be discussed with the DAQ and DSHW representatives.

Exhaust gas sampling procedures and frequencies to be used during this ATB are summarized in Table A-6-1. Sampling port locations for each train are shown in Figure A-6-1 for LIC1 and in Figure A-6-2 for LIC2. Figure A-6-3 shows a typical daily sampling schedule. Seven sampling trains will be used in six different ports in the duct. A combined Method 5/0050 sample train will be used to collect the PM and halogen emission samples. Other parameters will be determined using CEMS as shown in Table A-6-1. The isokinetic trains will determine the gas flow rate and the moisture concentration. Leak checks of the sample trains will be conducted in accordance with the protocol in each method prior to sampling, during port change, and at the conclusion of sample collection. The DAQ and DSHW will have the option of observing the leak checks.

The seven trains and constituents to be sampled are:

- Method 5/0050 (1) for PM, HF, HCl, and Cl₂;
- Method 29 (6) for HHRA metals;
- Method 0010 (1) for SVOCs;
- Method 0010 (7) for SVTOC and NVTOC;
- Method 0023A (1) for PCDDs/PCDFs;
- Method 0031 (1) for VOCs; and
- Method 0040 (7) for VTOC.

The two agent monitoring techniques operated by EG&G are ACAMS and DAAMS.

TABLE A-6-1. EXHAUST GAS SAMPLING SUMMARY

Sampling Train	Analyses Performed	Sampling Method Reference	Number Of Samples Collected during the LIC Mustard ATB (3 Runs)
DAAMS	Mustard	TE-LOP-522	15 sample sets
Method 1	Traverse Points	40 CFR 60, Appendix A	1
Method 2	Duct Velocity	40 CFR 60, Appendix A	With each isokinetic train
Isokinetic Trains	Exhaust Gas Moisture	40 CFR 60, Appendix A	With each isokinetic train
Method 5	PM	40 CFR 60, Appendix A	3 samples & 1 field blank
Method 0050	HCl and Cl ₂	SW-846, Method 0050	3 sample sets & 1 field blank
Method 29	HHRA Metals	40 CFR 60, Appendix A	3 sample sets & 1 field blank
Method 0010	SVOCs	SW-846, Method 0010	3 sample sets & 1 field blank
Method 0010 - TOC	SVTOC and NVTOC	Guidance for Total Organics(7)	3 sample sets & 1 field blank
Method 0031	VOCs	SW-846, Method 0031	12 trap pairs & 3 field blank pairs, & 1 trip blank pair
Method 0023A	PCDDs/PCDFs	SW-846, Method 0023A	3 sample sets & 1 field blank
Method 0040	VTOC	Guidance for Total Organics (7)	3 samples & 5 QC samples
CEMS	O ₂ and CO	Attachment 20 (5)	Continuously
CEMS	CO ₂ , NO _x , SO ₂ , & THC	40 CFR 60, Appendix A	Continuously

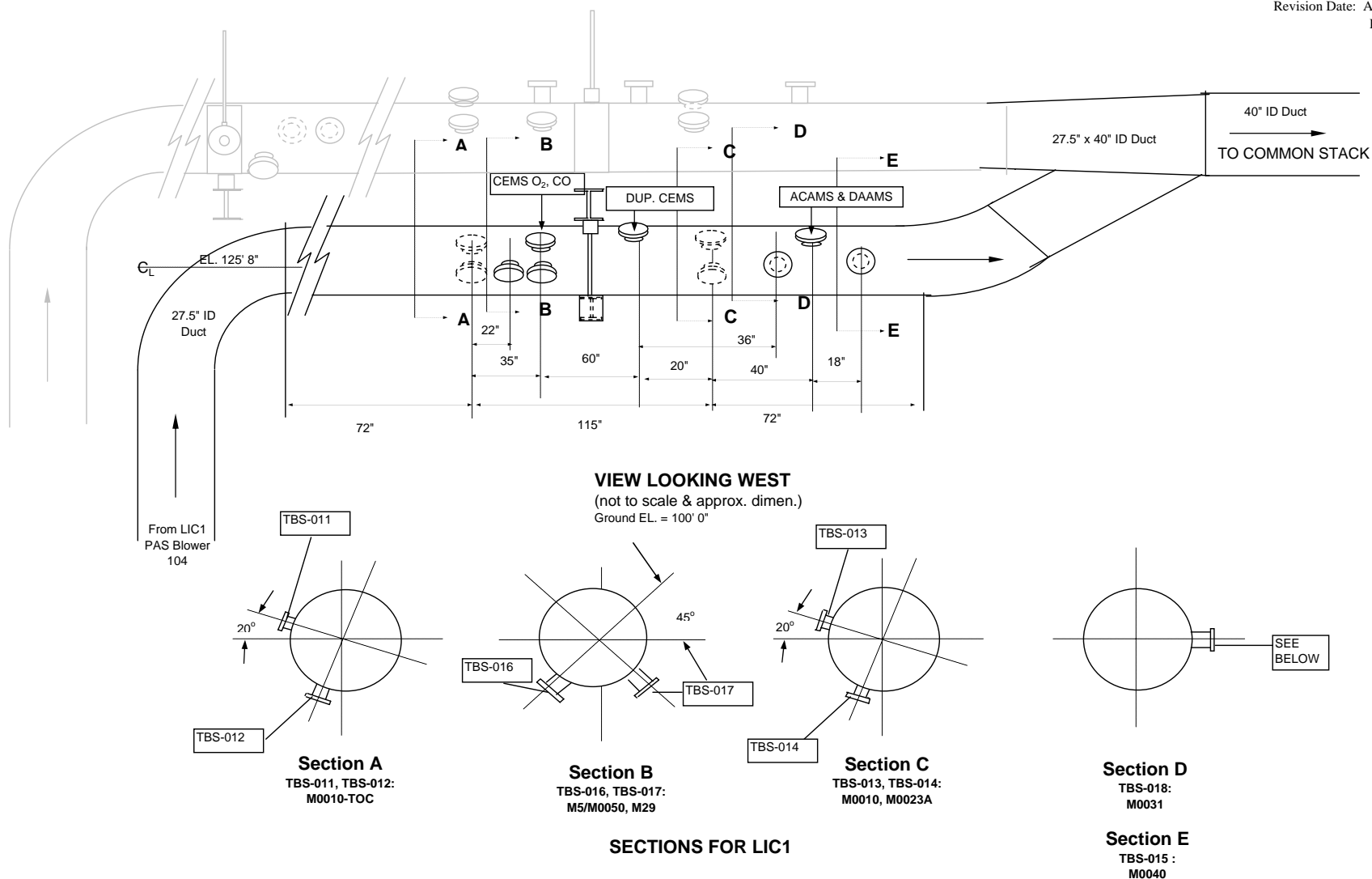


FIGURE A-6-1. LIC1 DUCT SAMPLING PORT LOCATIONS

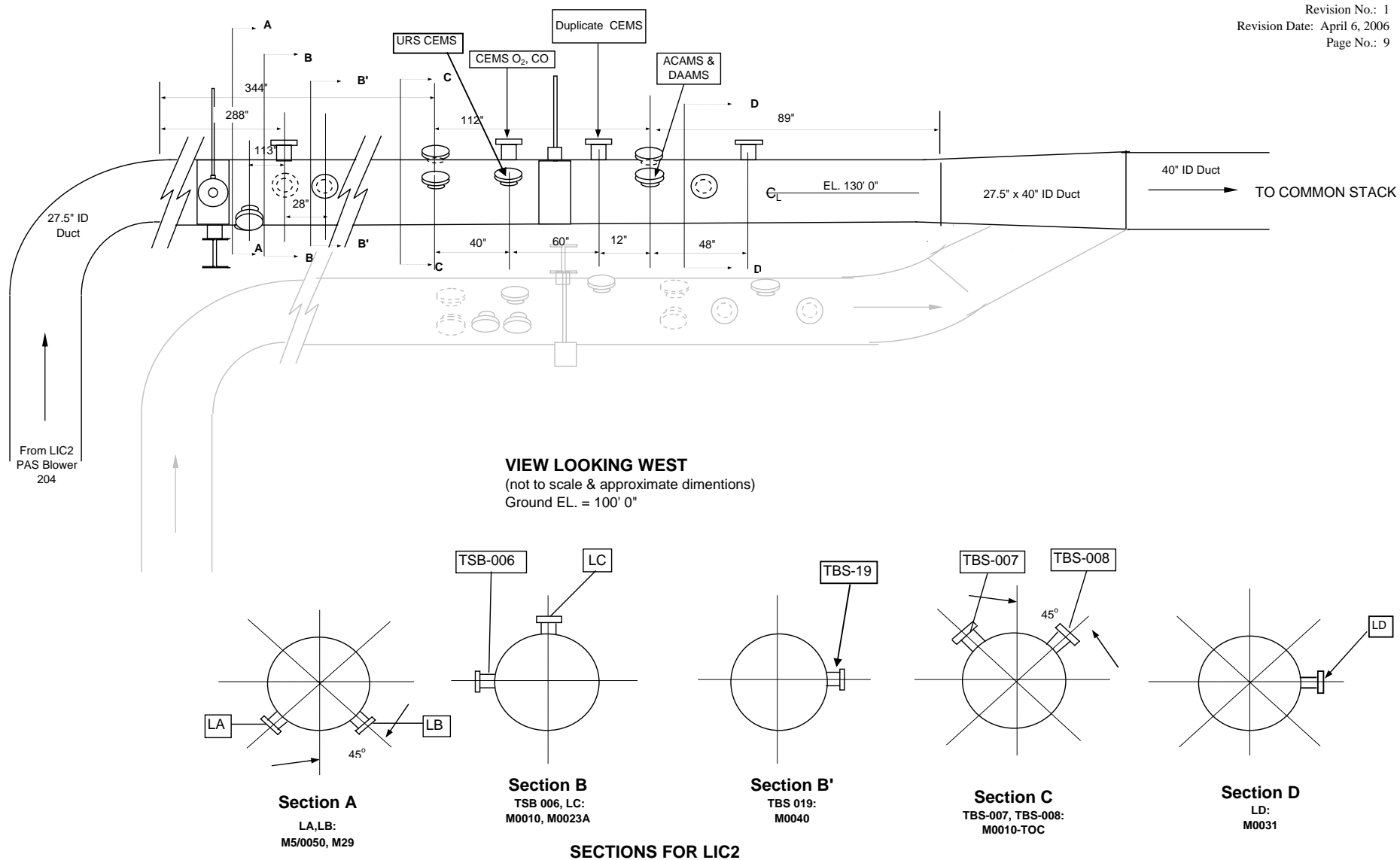


FIGURE A-6-2. LIC2 DUCT SAMPLING PORT LOCATIONS

LIC HD ATB Sampling Ports r1.xls
 LIC2 Duct Ports (2)

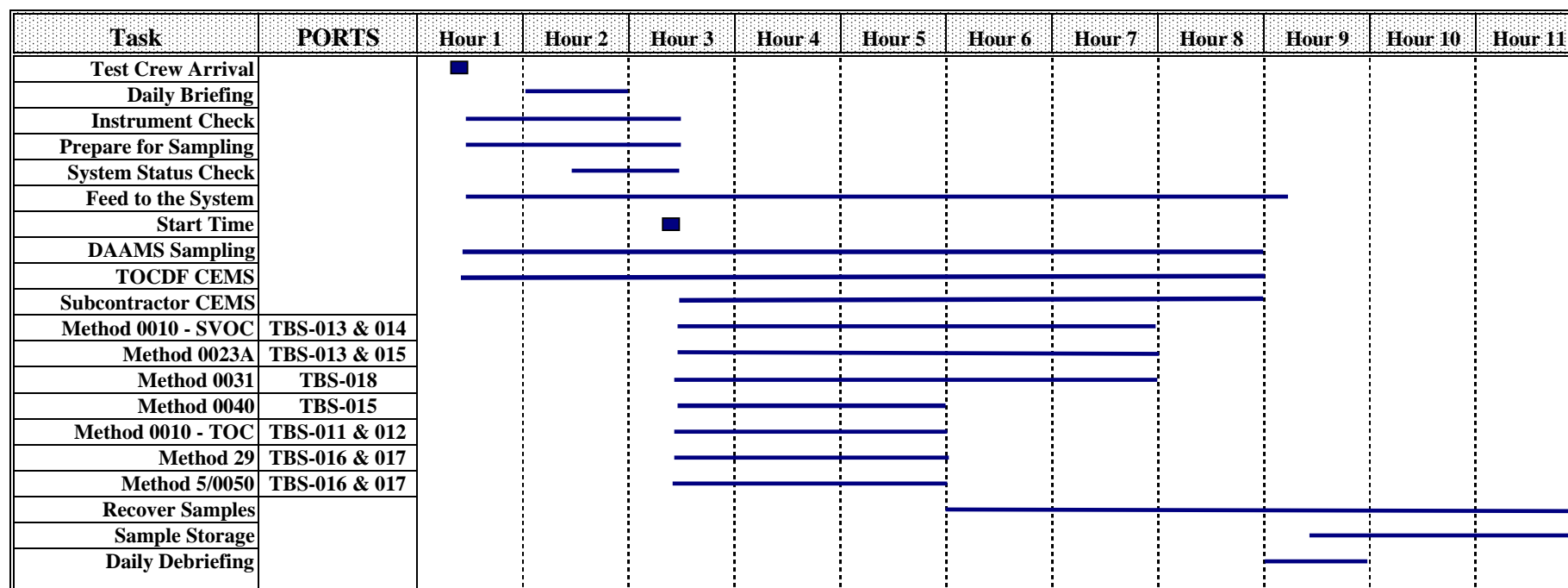


FIGURE A-6-3. EXAMPLE DAILY SAMPLING SCHEDULE FOR THE LIC MUSTARD ATB

6.3.1 Agent Monitoring Methods

Overall operation of the agent monitoring systems is discussed in the TOCDF "Agent Monitoring Plan" which is Attachment 22 to the TOCDF permit (8). Two different agent monitoring systems are used to determine agent concentrations in the plant and in the exhaust gas. The Army has provided all of the information the EPA and the DSHW have required regarding the development, testing, and evaluation of agent monitoring systems. These systems have undergone extensive testing and evaluation under both simulated and actual field conditions.

Mustard agent concentrations in the facility are monitored using ACAMS and DAAMS, and operation of these systems is controlled by LOPs. These systems use a GC with a Flame Photometric Detector (GC/FPD) for the detection of mustard agent. The GC column separates mustard agent from the other compounds, and the FPD is set for sulfur to detect the sulfur in the mustard agent as it elutes from the column.

Agent is monitored on a continuous basis to ensure that chemical agents are not emitted to the environment. An Automatic Waste Feed Cutoff (AWFCO) will be initiated if an ACAMS alarm occurs in the LIC Duct or the common stack. There are three scenarios of alarm:

- The first scenario is an ACAMS malfunction. A technician responds and determines that the ACAMS is malfunctioning. When the malfunction is resolved, feed resumes. The DAAMS tubes will be pulled and analyzed if there is any question that agent may be present. Agent feed will resume upon verification.
- The second scenario is an ACAMS alarm where only the stack ACAMS alarms. The DAAMS tubes from the common stack and all duct stations are analyzed. If agent is confirmed, the test is terminated; if no agent is confirmed, feed will resume, and sampling will resume when the LIC has stabilized.
- The third scenario involves an ACAMS alarm and indicates the possible presence of agent. Technicians respond to the alarm and determine whether the ACAMS is showing agent. The DAAMS tubes are pulled and analyzed; if the DAAMS tubes show agent, feed will not resume. Prior to re-initiating waste feed to the incinerator, EG&G and the Army will determine the cause and develop a course of action to prevent recurrence.

The precision and accuracy of each monitoring system is determined through actual on-site testing after the equipment has been installed. These data are used to establish quality control bounds, calibration and challenge frequencies, and procedures. These challenge frequencies and procedures are then delineated in a quality control plan for each system.

The following descriptions cover the various agent monitoring devices and address monitoring mustard agent.

6.3.1.1 Automatic Continuous Air Monitoring System

Mustard agent is detected by the ACAMS at Immediately Dangerous to Life or Health (IDLH) (high-level) limit, the Short Term Exposure Limit (STEL) (low-level) set by the U.S. Surgeon General for unmasked workers, and the Source Emission Limit (SEL) level. Operation of the ACAMS is covered by Tooele Laboratory Operating Procedure 524 (TE-LOP-524). The agents monitored by ACAMS will be controlled by Attachment 22 (8).

The ACAMS represents state-of-the-art instrumentation for the detection and quantification of chemical agents in both workplace and furnace exhaust gas environments. These two environments are substantially different in their composition and potential interferences. Exhaust gases are difficult to sample because of their high temperature and high moisture content. The ACAMS Dilution Air Flow Controller (ADAFc) is used in conjunction with the ACAMS to allow sampling directly from a duct. The purpose of the ADAFc is to condition the exhaust gas prior to sampling and analysis to allow for more accurate and repeatable results.

The ADAFc conditions the exhaust gas in two ways. First, it introduces clean, dry air (i.e., instrument air) to the exhaust gases before they enter the ACAMS. The gases going to the ACAMS are a combination of 5 % moist exhaust gas and 95 % dry instrument air. The instrument air lowers the dew point of the sampled gas, thereby preventing moisture from condensing in the sample lines or the ACAMS. The second function of the ADAFc is to maintain a constant ratio of clean air to exhaust gas in order for the ACAMS software to accurately quantify agent if present. When analyzing agent concentrations in the SEL or STEL modes of operation, the ACAMS uses a formula based on a measurement of total sample flow over a given amount of time. However, when an ADAFc is added to the system, the ACAMS measures a total sample volume (sample flow rate multiplied by the sample time), which is 49 times the actual sample volume from the duct. This dilution can be corrected by the calibration of the ACAMS and the associated software.

The ratio of dry air to sample must remain constant in order for the reported concentrations to remain accurate. These flows will be verified with a calibrated flow controller at the beginning and end of each run for the LIC Mustard ATB. There are two instruments used to measure the flow of the sample stream (5 %) and the dilution stream (95 %). The 5 % flow is measured with a 0.5 L/min flow instrument with an accuracy of ± 2 percent of full scale (± 10 mL/min). The 95 % is measured with a 2 L/min flow instrument with an accuracy of ± 2 percent of full scale (± 40 mL/min). The DAQ and DSHW will have the option to observe the verification of the 5 % exhaust gas to 95 % dry air ratio for the ACAMS monitors.

The evaluation and testing program for these units in the field is rigorous. The precision and accuracy data are generated while sampling actual exhaust gases during non-agent operations. The Limit of Quantitation (LOQ) of the ACAMS at the SEL level is 0.006 mg/m^3 for mustard agent. Testing and evaluation in all agent modes have been completed. All monitors met the 95 percent confidence level for ± 25 percent accuracy. The ACAMS cycle time in the mustard agent mode will be set during the shakedown period.

The ACAMS, which supplies quantitative agent data, provides enhanced detection capabilities. This monitoring system consists of a sampling pump, a sample collection module, a GC/FPD, monitor, strip chart recorder, and computer interface module for automated data acquisition. The ACAMS uses a GC column to separate compounds from agent and has the selectivity of the FPD to improve the specificity of the response to chemical agents.

The ACAMS cycle time is divided into a sample collection period, and a purging and analysis period. To provide continuous monitoring of the exhaust gas during the LIC Mustard ATB, there will be two ACAMS on-line and a backup at the LIC Duct sample location and also at the common stack. The instruments will be cycled so one ACAMS will sample the gas at each location while the second ACAMS is in the purge/analysis mode. If the common stack ACAMS cycle times are not in the correct sequence, an alarm will activate an AWFCO. The cycling of the LIC Duct ACAMS will be verified on an hourly basis by the ACAMS operators. The third ACAMS is held in reserve to be used if an ACAMS fails. The additional ACAMS also allows the primary ACAMS to be challenged off-line without affecting the ability to continuously monitor the exhaust gas.

6.3.1.2 Depot Area Air Monitoring System

The DAAMS is a sampling method capable of detecting mustard agent in exhaust gas at concentrations determined to be safe for human health and the environment as established by the U.S. Surgeon General. The agents monitored by the DAAMS will be controlled by Attachment 22 (8). Collection of samples on the DAAMS tubes is covered by TE-LOP-522, and analysis of the DAAMS tubes is covered by TE-LOP-562. It is necessary to use a DAAMS Dilution Air Flow Controller (DDAFC) to monitor hot, moist exhaust gases with DAAMS tubes. The volume of air flowing through a DAAMS tube is composed of 5 % moist exhaust gas and 95 % dry instrument air. The average flow rate from the DDAFC will be used in the calculation of the total flow to the DAAMS tubes. The DDAFC is used to lower the exhaust gas dew point to allow the sample to be collected on the sorbent for subsequent analysis. The TOCDF CAL will perform the analysis of the DAAMS tubes. The PQL for the DAAMS tube mustard agent analysis at the SEL level is 0.006 mg/m^3 .

The DAAMS tubes will be used to determine the agent concentrations for the DRE calculation for this ATB. In the case of an ACAMS alarm, the sample time used to calculate the DAAMS

concentration will be equal to the length of time the ACAMS is in alarm. If the normal DAAMS sample period ends during the alarm condition, the sampling period will be extended until the ACAMS clears to avoid missing any mustard agent in the exhaust gas. The DAAMS sampling period for DRE during the LIC Mustard ATB will be one hour unless there is an agent alarm.

Each set of DAAMS tubes consists of four glass tubes filled with solid sorbent. One tube is a field surrogate (QP sample) tube with mustard agent spiked onto the tube to verify that the mustard agent is not removed from the tube by the sampling process. The other three tubes are certified clean by the CAL before being sent to the field. The tubes are set up in a manifold so that they can sample from the same gas stream. The diluted exhaust gas passes through the tubes; the solid sorbent in the tubes retains the organic compounds present. The flow through each tube is measured before and after sample collection, and the average flow is used to calculate the sample volume.

The exhaust gas flow and the instrument airflow will be verified with calibrated flow controllers at the beginning and the end of each performance run. There are two instruments used to measure the flow of the sample stream (5 %) and the dilution stream (95 %). The 5 % flow is measured with a 0.5 L/min flow instrument with an accuracy of ± 2 percent of full scale (± 10 mL/min). The 95 % is measured with a 10 L/min flow instrument with an accuracy of ± 2 percent of full scale (± 200 mL/min). The lowest flow will be used for the DRE calculations. The DAQ and DSHW will have the option to observe the verification of the 5 % exhaust gas to 95 % dry instrument air ratio for the DAAMS monitors. Each DAAMS set will be leak checked during this ATB.

6.3.2 Method 0031 for Volatile Organic Compounds

The VOCs will be sampled using SW-846, Method 0031, "Sampling Method for Volatile Organic Compounds (SMVOC)" (1). The SMVOC draws exhaust gas through a series of three sorbent traps. Four sets of traps will be collected per run. Sampled gas will be passed through each set of traps for about 40 minutes. The sorbent traps will be conditioned as described in Section 6.1.4. The collection of the four sets of traps will result in 160 minutes of sampling, which exceeds the 120 minutes the method specifies as a minimum.

The SMVOC probe removes exhaust gas from the duct at a probe temperature of $130\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ ($266\text{ }^{\circ}\text{F} \pm 9\text{ }^{\circ}\text{F}$) during sampling. The exhaust gas passes through a condenser and two traps containing about 1.6 grams of Tenax® resin each. The exhaust gas then passes through a knockout flask that collects condensed water. Following that, the gas passes through a second condenser and through the third trap containing about 5 grams of Anasorb®-747. Each water-cooled condenser is arranged so that condensate will drain vertically through the traps. The traps are arranged in series, so the majority of the compounds will be trapped on the Tenax® resin.

The Anasorb®-747 in the third trap will retain the gaseous compounds. New Teflon® sample transfer lines will be used for the LIC Mustard ATB, and the sampling train will use greaseless fittings and connectors. The exhaust gas will be sampled at approximately 0.5 L/min (20 L/sample). Analyses of the SMVOC tubes will follow SW-846, Method 5041A (1).

The condensate collected in the SMVOC flask will be transferred to a 40-mL VOA vial with Teflon® lined septa. The flask will be rinsed three times and the rinseate transferred to the VOA vial. The vial will then be filled to the top with organic-free water. The condensate will be analyzed using Method 8260B.

The laboratory performing the analyses will supply the SMVOC tubes. The tubes contain gas chromatography quality Tenax® and Anasorb®-747. These tubes will be used without further cleanup. The tubes will meet the "blank" criteria and will be consistent with the requirements of the method. The supplier will provide an analysis for each batch of SMVOC tubes used.

Extra sorbent tubes will be taken to the sampling site to serve as field blanks and trip blanks. One pair of SMVOC tubes, designated as a field blank, will be removed from their containers, attached to the sampling train, and leak checked. The field blank tubes will be recovered and stored for transport in the same manner as the sample-exposed tubes. A field blank will be collected for each run. One set of tubes will act as a trip blank and will not be opened at the site. All of the blanks will be analyzed by the same method as the actual samples. The SMVOC tubes will be stored at < 10 °C and away from other samples, both before and after sampling, to minimize potential contamination.

6.3.3 Method 0040 for Volatile Total Organic Compounds

SW-846, Method 0040, gives a measure of the VTOC present in the exhaust gas stream. The sample consists of a gas sample in a bag and a condensate sample stored in a VOA vial with no headspace. The sample is collected by drawing a vacuum on a container holding a Tedlar™ bag. The vacuum on the outside of the bag causes the bag to inflate with gas withdrawn by a heated probe from the exhaust gas stream. The gas passes through a heated filter, and then is cooled in a condenser with the condensate collected in a knockout flask. The gas then fills the sample bag, and the bag will be analyzed within 2 hours of collection. One sample and a field blank will be collected each day. The condensate sample will be analyzed within 14 days of sample collection.

6.3.4 Method 1 to Determine Duct Traverse Sampling Points

The number and location of the exhaust gas sampling points will be determined according to the procedures outlined in Method 1, "Sample and Velocity Traverses for Stationary Sources" (6). The sampling locations must meet the criteria specified in Method 1, and the number of sampling traverse points will be 24.

6.3.5 Method 2 to Determine Exhaust Gas Velocity and Volumetric Flow Rate

The exhaust gas velocity and volumetric flow rate will be determined using Method 2, "Determination of Stack Gas Velocity and Volumetric Flow (Type S Pitot tube)" (6). Velocity measurements will be made using Type S pitot tubes, which will be calibrated by conforming to the geometric specifications outlined in Method 2 or in a wind tunnel against a standard pitot. The differential pressures will be measured with fluid manometers, and the effluent gas temperatures will be measured with chromel-alumel thermocouples equipped with digital readouts.

6.3.6 Exhaust Gas Moisture Content

The exhaust gas moisture content will be determined in conjunction with each isokinetic sampling train as directed in Method 5 (6). The impingers will be connected in series and will contain reagents as described in the following sections. The impingers will be placed in an ice bath to condense the moisture in the exhaust gas sample. Any moisture that is not condensed in the impingers is captured in the silica gel. Moisture will be determined by weighing the impingers.

6.3.7 Combined Method 5/0050 for Particulate Matter and Halogens

A combined train will be used to determine concentrations of PM, HF, HCl, and Cl₂. Sample collection will be conducted as directed by Method 5 (6). A quartz-fiber or Teflon® mat filter will be used. The filter will be weighed before sampling and after desiccating as directed in Method 5. Nozzles, probe liners, and filter holders will be rinsed thoroughly prior to testing. Samples will be collected for a minimum of two hours.

The impinger configurations used in the train are:

- Impinger 1: Condensate impinger containing 50 mL of 0.1 N H₂SO₄.
- Impingers 2 and 3: Greenburg-Smith impingers containing 100 mL of 0.1 N H₂SO₄.
- Impingers 4 and 5: Modified Greenburg-Smith impingers containing 100 mL of 0.1 N NaOH.
- Impinger 6: Modified Greenburg-Smith impinger containing silica gel.

The sample is withdrawn isokinetically from the exhaust gas, while the temperature of the sample probe and the filter housing are maintained at 248 °F (± 25 °F). The sampling runs will be performed within ± 10% of isokinetic conditions. The probe rinse and the material collected in the filter housing will be used to determine the PM emissions. This method does not require the sample fractions to be cooled; therefore, the samples recovered from this train will not be cooled as a preservative step.

An ion chromatograph (IC) will be used to analyze the impinger solutions. The HF and HCl emissions will be determined from the analysis of the H₂SO₄ impinger solutions and the Cl₂ emissions are determined from the analysis of the NaOH impingers. Chlorine is absorbed by the basic solution and disassociates to form sodium chloride and sodium hypochlorite (NaOCl). The sample recovery of the NaOH impingers will include the addition of sodium thiosulfate (Na₂S₂O₃) to reduce any NaOCl to chloride ion. This will result in two moles of chloride ion for each mole of Cl₂ present in the exhaust gas sample.

Reagent blanks will be analyzed. A field blank will be prepared with the same components as a regular train and recovered using the same amount and type of reagents. The field blank will be collected as directed by the method and the recovered field blank samples will be analyzed the same as for the other trains.

6.3.8 Method 0023A for PCDDs/PCDFs

Method 0023A (1) will be used to sample the exhaust gas for PCDDs/PCDFs during each performance run. The Method 0023A sample train will collect exhaust gas for four hours. The minimum sample volume collected will be 120 dry standard cubic feet (dscf). Exhaust gas is extracted isokinetically through ports in the horizontal duct using a heated borosilicate glass-lined probe. Sampling train connections are made with Teflon® and glass. The PM is removed by a glass fiber filter housed in a glass filter holder maintained at 248 °F (± 25 °F). The sample gas passes through a water-cooled condenser and XAD-2® sorbent trap for removal of the organic compounds, which are arranged in a manner that allows the condensate to drain vertically through the XAD-2® trap. The gas temperature at the entrance to the resin trap will

be maintained below 68 °F. A chilled impinger train is used to remove water from the exhaust gas, and a dry gas meter will be used to measure the sample gas volume.

Mobile laboratory trailers will be used for sample train assembly and recovery. Recovery of the Method 0023A samples and assembly of the sample trains will be conducted in an environment that is free from uncontrolled dust. The samples will be processed for analysis within the holding time requirements described in Section 7.0.

Blanks of each solvent lot used will be saved for potential analysis. A field blank will be prepared and recovered as directed by the method. The field blank will be leak checked and then allowed to sit for the sampling time of the train. The recovered samples will be shipped to the laboratory and analyzed in the same manner as the recovered samples from the other trains.

After sample collection, the recovered sample fractions will be cooled at $\leq 4^{\circ}\text{C}$ until they are shipped to the laboratory for analysis. Samples received at the laboratory will be combined into two sample fractions for analysis. One fraction will contain the probe rinse and the filter extract with surrogates added to the filter. The second fraction will contain the XAD-2® extract and the back half rinse with field surrogates added to the XAD-2® resin before sampling.

6.3.9 Method 0010 for Semi-Volatile Organic Compounds

SW-846, Method 0010 (1), will be used to collect a minimum sample volume of 120 dscf of exhaust gas for SVOCs. Exhaust gas is extracted isokinetically from ports in the LIC Duct through a glass nozzle and a borosilicate glass-lined probe. Sampling train connections will be Teflon® and glass. The PM is removed from the gas sample by a glass fiber filter housed in a glass filter holder maintained at 248 °F (± 25 °F). The sample gas passes through a water-cooled condenser and into the XAD-2® sorbent trap that collects the SVOCs. The condenser and XAD-2® sorbent trap are arranged to allow the condensate to drain vertically through the trap. The gas temperature at the entrance to the resin trap will be ≤ 68 °F. The chilled impinger train removes water from the exhaust gas, and a dry gas meter measures the sample volume.

Mobile laboratory trailers will be used for sample train assembly and recovery. Recovery of the Method 0010 samples and assembly of the sample trains will be conducted in an environment that is free from uncontrolled dust. Containers used for the recovered samples will be labeled during recovery procedures. After sample recovery, the sample fractions will be cooled at $\leq 4^{\circ}\text{C}$ until they are shipped. The sample fractions will be recorded on COC forms, packed in ice, and shipped to the laboratory for analysis. The samples will be processed for analysis within the holding time requirements described in Section 7.0.

Blanks of each solvent lot used will be saved for potential analysis. A field blank will be prepared and recovered as directed by the method. The field blank will be leak checked and then allowed to sit for the sampling time of the train. The recovered samples will be shipped to the laboratory and analyzed in the same manner as the recovered samples from the other trains.

6.3.10 Method 0010 for Total Organic Compounds

SW-846, Method 0010 will be used to sample exhaust gas emission for SVTOC and NVTOC during each run. A minimum of 60 dscf of sample volume will be collected. Exhaust gas is extracted isokinetically from ports in the LIC duct through a glass nozzle and a borosilicate glass probe. Sampling train connections will be Teflon® and glass. The PM is removed from the gas sample by means of a glass fiber filter housed in a glass filter holder maintained at 248 °F (± 25 °F). The sample gas passes through a water-cooled condenser and into the XAD-2® sorbent trap to collect the organic compounds. The condenser and XAD-2® trap are arranged so the condensate drains vertically through the trap. The gas temperature at the entrance to the resin trap will be ≤ 68 °F. The chilled impinger train removes water from the gas sample, and a dry gas meter will be used to measure the sample volume.

Recovery of the TOC sample trains will be as directed in the EPA Guidance (7). Mobile laboratory trailers will be used for sample train assembly and recovery. Recovery of the Method 0010 samples and assembly of the sample trains will be conducted in an environment that is free from uncontrolled dust. Containers used for the recovered samples will be labeled during recovery procedures. After sample recovery, the sample fractions will be cooled at $\leq 4^{\circ}\text{C}$ until they are shipped. Sample fractions will be recorded on the COC, packed in ice, and shipped to the laboratory. Samples will be analyzed within the holding time listed in Section 7.0.

Blanks of each solvent lot used will be saved for potential analysis. A field blank will be prepared and recovered as directed by the method. The field blank will be leak checked and allowed to sit for the sampling time, and the recovered samples will be analyzed by the same method as the other TOC samples.

6.3.11 Method 29 for Metals

Metal emissions will be sampled using Method 29 (6). The set up, pretest preparations, and leak-check procedures are the same as outlined in Method 5 (6). Impinger configurations are:

- Impinger 1: Empty modified Greenburg-Smith, to serve as a knockout.
- Impinger 2: Modified Greenburg-Smith containing 100 mL of 5% HNO_3 and 10% H_2O_2 .
- Impinger 3: Greenburg-Smith containing 100 mL of 5% HNO_3 /10% H_2O_2 .
- Impinger 4: Empty modified Greenburg-Smith.
- Impingers 5 and 6: Modified Greenburg-Smith containing 100 mL each of 4% KMnO_4 and 10% H_2SO_4 .
- Impinger 7: Modified Greenburg-Smith containing silica gel.

The sample train will be recovered as directed by Method 29 (6) with the exception that 250 mL of acid will be used to rinse the back-half of the filter and the transfer line. Rinse the front half of the train with exactly 100-mL of 0.1 N HNO_3 including the probe nozzle, probe liner, and front half of the filter holder into a tared sample bottle. The amount of acid should be measured and transferred to an empty wash bottle labeled “front half rinse”. When the rinse is complete, cap the bottle and determine the weight of rinse used. Record the weight of the rinse on the field sample recovery sheet. Place 250 mL of acid in a second wash bottle and label it “back half rinse”. Use this wash bottle to rinse the back half of the filter housing, the transfer line, and the first three impingers. Add these rinses to the impinger contents, cap the bottles, and record the weight of acid used in the rinse on the field sample recovery sheet. The fourth impinger will be recovered separately with a 0.1 N nitric acid rinse. Impingers 5 and 6 will be rinsed with KMnO_4 impinger solution, and DI water. These rinses will be combined with the collected impinger catch from these two impingers, which are then rinsed with 8 N HCl ; this rinse is kept separate.

Six sample fractions will be analyzed from the Method 29 train. The front-half fraction consists of the acid digestion of the filter and the rinse of the probe, nozzle, and filter holder front half. The back-half fraction consists of the contents of the first three impingers and their rinses along with the rinse of the back half of the filter holder. These two fractions will be analyzed for the HHRA metals. Impinger 4 and its rinse will be analyzed for mercury only. Impingers 5 and 6 and their rinses will be analyzed for mercury only, and the acid rinse of impingers 5 and 6 will also be analyzed separately for mercury only as well. The sample fractions are acid solutions, and the acid will preserve the samples. Method 29 (6) does not require cooling the samples; therefore, the samples will be shipped without cooling.

The reagent blanks will be prepared as directed by Method 29 with the exception that 250 mL of acid is used for the back half reagent blank in place of the 100 mL of acid. Analyze the reagent blanks to determine if significant amounts of metals are added through the reagents. The reagent blank will be used to make the corrections as called for in Sections 12.6 and 12.7 of Method 29.

A field blank will be prepared with the same components as a regular train and recovered using the same reagent amounts. The field blank will be leak checked and then allowed to sit for the sampling time. Recovered samples will be analyzed using the same methods as field samples.

6.3.12 Continuous Emissions Monitoring

The CEMS operated by EG&G as part of the environmental permits will be used to monitor the O₂ and CO concentrations. The operation, calibration procedures, and preventive maintenance procedures for the CEMS are described in Attachment 20 of the TOCDF RCRA Permit (5), which also describes specific locations, sampling frequencies, and the specific types of instrumentation for each monitoring station. Attachment 20 of the TOCDF RCRA Permit (5) describes the monitoring system that is used to provide continuous operational control of the LICs and to meet the requirements listed in the RCRA Permit and Title V permit. A Relative Accuracy Test Audit (RATA) will be conducted prior to the LIC Mustard ATB as directed by the HWC MACT regulations.

The CO and O₂ CEMS data will be recorded continuously during each test. The sampling ports for the monitors are located in the LIC Duct. The CO concentration will be determined using monitors 13-AIT-083 and 24-AIT-078 (13-AIT-778 and 13-AIT-716), and the O₂ concentrations will be determined with monitors 13-AIT-229 and 24-AIT-210 (13-AIT-798 and 24-AIT-717). These monitors will be checked against reference standards daily, at a minimum. Zero and span checks will be considered a verification of the CEMS data quality. If the zero and span checks indicate unacceptable CEMS results for accuracy and precision, then the monitor will be recalibrated according to the manufacturer's specifications. The Process Data Acquisition and Recording System (PDARS) will record the CEMS data, which will be used for O₂ corrections.

Each year, the CEMS are certified by on-site testing and calibrations. Guidelines are delineated in a quality control plan and laboratory operating procedure for each CEMS. In addition to the annual certification, an Absolute Calibration Audit (ACA) will be conducted quarterly as directed by the HWC MACT regulations. The QC plans, including bounds, calibration frequency, and procedures are discussed in Attachment 20 of the TOCDF RCRA Permit (5).

Additional parameters will also be monitored using CEMS operated by the sampling subcontractor. These CEMS will be used to monitor for CO₂, NO_x, SO₂, and THC. The

subcontractor will determine the exhaust gas molecular weight and report the data from each of the monitors. Each individual CEMS will be calibrated as directed in the respective methods.

6.4 PROCESS SAMPLING

Table A-6-2 lists the sample streams, analyses to be performed, sampling method, sampling frequencies, and sample volumes. The process samples will be collected using American Society of Testing and Materials (ASTM) methods. Liquid samples will be collected from taps provided for sample collection, and residue samples will be taken using scoops. Field duplicates of the Brine, Decon, and neat agent samples will be collected during one run.

TABLE A-6-2. PROCESS SAMPLES TO BE COLLECTED

Sample Stream	Analysis Performed	Sampling Method	Sampling Frequency	Sample Volume
Wet Scrubber Recirculation Brine*	Mustard, pH, HHRA Metals, VOCs, SVOCs, PCDDs/PCDFs, PCBs	Tap, ASTM Method D3370	One Sample per Run	Three 40-mL VOA vials, one 500-ml, and two 1-L bottles
Spent Decon Solution*	Mustard, HHRA Metals, VOCs, SVOCs, PCBs, PCDDs/PCDFs	Tap, ASTM Method D3370	One Sample per Run	Three 40-mL VOA vials, one 500-ml and two 1-L bottles
Process Water	HHRA Metals, VOCs, SVOCs	Tap, ASTM Method D3370	One Sample per ATB	Three 40-mL VOA vials, one 500-ml and two 1-L bottles
NaOH Makeup	HHRA Metals, VOCs, SVOCs	Tap, ASTM Method D3370	One Sample per ATB	Three 40-mL VOA vials, one 500-ml and two 1-L bottles
Agent*	Purity, Organic Impurities, HHRA Metals,	TE-LOP	One Sample per Run	One sample tube containing 2 to 5 mL of neat agent
Slag Residue	HHRA Metals, TCLP Metals	Grab, ASTM D5633	One Sample per ATB	One 500-mL and one 1-L bottle

* One run will have a duplicate set of samples collected.

6.4.1 Process Stream Sampling Locations

Process streams sampled as part of the LIC Mustard ATB include the agent waste feed, Decon, Brine, metals spiking solution, slag, NaOH makeup, and process water. Mustard agent samples will be collected from a valve in the strainer housing on the agent line exiting the Agent Collection System (ACS) tanks. A grab sample of Decon is taken from the SDS tanks at the Agent Sampling Room (ASR) glove box sampling station. If the ASR glove box is not available, the Decon sample will be taken using a valve on the SDS tank. The contents of the SDS tank will be mixed before collection of the sample. The Decon samples are collected before the run begins to allow the contents to be agent screened before the Decon is processed. If additional NaOCl is added to the SDS tank, then new samples will be collected when the new agent screen sample is collected.

After this ATB, an attempt will be made to drain the slag. If slag is collected, slag samples will be taken from the cooled slag drums, and the analyses will be included in the ATB Report.

The remaining process samples will be collected from locations that are accessible to the sampling subcontractor. The Brine and NaOH samples will be taken via taps on the discharge of the pumps used to move the solutions. The process water sample will be collected from a tap on the supply line in the Pollution Abatement System (PAS). Samples of the metals spiking solutions will be collected from taps on the liquid delivery system at a location that will prevent fluctuations in the delivery pressure or flow of the spiking solution to the LIC.

6.4.2 Tap Sampling Method

Liquid process samples will be collected using the method described by the ASTM Method D3370 (9). The sample will be collected by attaching a sample line to the tap and flushing the sample line. The flush will be managed in accordance with applicable EPA and DSHW regulations. The sample line is inserted into the sample container, and the tap is opened so that the sample fill time exceeds one minute. This sampling flow reduces the loss of volatile compounds from the sampling container prior to closing the container. This method ensures that the actual material collected is representative of the stream. Separate sub-sample bottles are used for each sample. Brine samples will be collected during the final 60 minutes of the run and other samples will be collected throughout the run. The Decon samples will be collected before the runs to allow the agent screen to be preformed before processing the Decon. Samples of the NaOH makeup and process water will be collected during one of the runs using this method.

6.4.3 Mustard Agent Sampling Method

Samples collected for the analysis of the mustard agent purity will be taken from the ACS tanks.

The contents of the ACS tank will be mixed a minimum of 30 minutes before beginning feed to the LIC to ensure the contents of the ACS tanks are mixed. Mixing the contents will allow a single sample to be collected for each run. If the tank mixing system is unavailable for the ATB, three samples will be collected and composited for each run. One run will have a duplicate agent sample collected. A 35-mL sample will be collected from the tap on the discharge line. The samplers will transfer 3 to 5 mL of mustard agent from the 35-mL sample into a sample tube. The sample tube will be air washed and monitored until it is safe to transfer to the CAL for analysis.

6.4.4 Slag Sample Collection

An attempt will be made to drain the slag from the LIC at the conclusion of this ATB. If slag will not drain, a slag sample will not be collected. If slag can be drained, it will be placed in drums and a sample of the slag will be collected from the drum containing the cooled slag. A laboratory scoop will be used to collect a sample from the drum using ASTM Method D5633 (10). A representative sample of the slag will then be removed and placed in amber glass bottles with Teflon®-lined lids.

6.5 PROCESS MONITORING EQUIPMENT

Process electronic data output will be monitored carefully by incinerator operators in order to maintain steady-state operating conditions during the LIC Mustard ATB. Process monitoring equipment will be inspected and calibrated periodically. Where duplicate monitors or methods of determination exist, the data generated will be compared for consistency. EG&G will be responsible for collecting operations data, the permit-required monitoring information, and system operating data in accordance with Standard Operating Procedures (SOPs). The process data to be collected includes:

- Primary Combustion Chamber (PCC) exhaust gas temperature and PCC pressure;
- Secondary Combustion Chamber (SCC) exhaust gas temperature and SCC exhaust gas delta pressure;
- Feed rate;
- Quench brine pressure, quench brine pH, and quench brine density;
- Quench exhaust gas temperature;
- Venturi delta pressure and venturi brine flow;
- Clean liquor flow to scrubber, clean liquor pH, and clean liquor delta pressure;
- CO concentration and O₂ concentration; and
- Residence time.

6.6 POST-SAMPLING ACTIVITIES

Any wastes generated during sample collection will be handled in a safe manner. Liquid wastes will be placed in appropriately-sized containers at a satellite collection point.

7.0 SAMPLE HANDLING, TRACEABILITY, AND HOLDING TIMES

This section describes the sample preservation methods, holding times, field documentation and shipping requirements. Process stream samples will be collected by the sampling subcontractor with the exception of the neat agent samples, the Decon samples, and the slag sample. Exhaust gas samples will be collected by the sampling subcontractor with the exception of the DAAMS tubes for mustard agent analysis. Neat agent samples, Decon samples, and the slag sample will be collected by EG&G operations personnel, who will label and transport the samples to the CAL for analysis. The DAAMS tubes will be collected by Battelle monitoring personnel, who will label and transport the samples to the CAL for analysis.

7.1 SAMPLE PRESERVATION AND HOLDING TIMES

Requirements for preserving samples and holding times were taken from Table 3-1 in SW-846 (1) and the QC Handbook (4), and are shown in Table A-7-1. The sampling and packaging technicians will preserve the samples as directed by Table A-7-1. Samples requiring cooling will be maintained at $\leq 4^{\circ}\text{C}$ until shipped in a cooler packed with ice, and sample temperatures will be monitored upon receipt at the laboratory.

Samples requiring acidification will have acid added during sample collection. Samples of the Brine and NaOH make-up solution will not be acidified in the field due to the large volume of acid necessary to acidify these samples. Samples from the Method 29 train will be in acid solutions from the sample recovery, and additional acid will not be added.

Holding times will be monitored by keeping track of the time following sample collection. The holding time for the mustard agent samples will be 150 days from collection. Little change is anticipated in the mustard agent sample composition with time. Samples will be delivered or shipped to the laboratory as necessary to meet the holding times for the sample analyses.

7.2 DOCUMENTATION

The following subsections present the requirements for labeling, maintaining the COC, and handling environmental samples. Recording information necessary for reconstruction of the sampling event will be discussed. Entries made on the following documents will use the error correction protocol of drawing one line through the error, then initialing and dating the change. Documentation will be made available to the DAQ and DSHW upon request.

TABLE A-7-1. SAMPLE PRESERVATION AND HOLDING TIMES

Parameter	Preservation	Holding Time
Process Streams (Residue)		
Metals	Cool ($\leq 4^{\circ}\text{C}$) pH < 2 Unpreserved	6 months (28 day Hg) 28 days (14 days Hg)
VOCs	Cool ($\leq 4^{\circ}\text{C}$)	14 days
SVOCs	Cool ($\leq 4^{\circ}\text{C}$)	Extract 14 days, Analyze 40 days
PCDDs/PCDFs	Cool ($\leq 4^{\circ}\text{C}$)	Extract 30 days, Analyze 45 days
Agent	None	30 Days
Exhaust Gas		
Method 5 - PM	None Required	28 days
Method 0050 – Sulfuric Acid Solutions	No Additional Required	28 days
Method 0050 – Sodium Hydroxide Solutions	2 mL of 0.5 <u>M</u> $\text{Na}_2\text{S}_2\text{O}_3$	28 days
Method 29	No Additional Required	28 days
DAAMS Tubes	None Required	14 days
VTOC	None Required	2 hours
SMVOC Tubes and Condensate	Cool ($\leq 4^{\circ}\text{C}$)	14 days
Method 0010	Cool ($\leq 4^{\circ}\text{C}$)	Extract 14 days, Analyze 40 days
Method 0023A	Cool ($\leq 4^{\circ}\text{C}$)	Extract 30 days, Analyze 45 days

7.2.1 Sample Labels

Sample labels are necessary to prevent misidentification of samples. Therefore, the samples collected by the sampling subcontractor will be labeled following a designated code system developed by the STC for this project. Samples will be sealed and the volume of the sample marked. The data from each sample run will be recorded on a run sheet during each performance run, and after each run, the data will be checked for completeness. The sampling subcontractor will then complete the appropriate COC forms to be sent to the laboratory, and the samples will be packaged for shipment. A designated field technician will take custody, sign the COC forms, and deliver the samples to the laboratory. The field technician will sign the appropriate forms relinquishing custody, and the laboratory representative will sign the form indicating that they have taken custody of the samples. Examples of the sampling subcontractor's COC forms and other sampling documentation can be found in Annex B.

The CAL personnel label the DAAMS tubes by marking them with a unique number. Gummed-paper labels or tags will be used to identify the other samples. The labels will include at least the following information:

- A sample number, including a sample code that distinguishes field samples, duplicates, or blanks where appropriate.
- A signature or the initials of the sample collector.
- The date and time of collection.
- The incinerator designator and trial run number.
- The type of preservative used, or "None," as applicable.

Labels will be affixed to sample containers prior to, or at the time of, sampling. However, the labels will be filled out at the time of sample collection.

7.2.2 Sample Seals

Sample seals are used to detect improper handling of samples from the time of sample collection through the time of analysis. Items such as gummed paper seals and custody tape will be used for this purpose. Signed and dated seals will be attached so that they must be broken to open either the individual sample containers or shipping containers. Seals will be affixed to containers before the samples leave the custody of the sampling personnel.

7.2.3 Sample Collection Logbook

Information pertinent to sampling will be recorded in a sampling logbook, which shall be bound and contain consecutively numbered pages. All entries will be made in indelible ink, and all corrections will follow the error correction protocol of drawing one line through the error, then initialing and dating the correction. Sampling personnel will also record all information on the appropriate sampling forms.

At a minimum, entries in a logbook for the exhaust gas samples shall include:

- The purpose of the sampling event.
- The location and description of the exhaust gas sampling ports and the sampling points for the process samples.
- Documentation of procedures for preparation of reagents or supplies that become an integral part of the sample (e.g., reagents in impingers).
- Identification of sampling crew members.
- The type of samples collected.
- The sampling methodology.
- The date and times of sampling events.
- Any general observations.
- Any deviations from the sampling methods.

7.2.4 Chain-of-Custody Forms

The purpose of COC procedures is to document the identity of the sample and its handling, from collection through all transfers of custody. To establish the documentation necessary to trace sample possession from the time of collection, a COC record must be filled out and accompany every sample or group of individually identified samples. When a sample arrives at the laboratory, an individual with the COC authority who is trained in the laboratory sample receiving and control methods will take custody of the samples. The sample coolers will be opened by the sample custodian or designee and logged into the master sample log. A laboratory internal COC form will be completed, and the sample will be placed in locked storage. Laboratory analysts will sign out samples prior to analysis. The sample custodian will use a standard form to record the location of the sample and any transfers of the sample to analytical personnel. The laboratory sample custodian will keep the form until the project is complete. The forms will then be transferred to Document Control with the project file.

The COC for the sampling trains will be established when the sampling crew take possession of the sample train components. Either the entire sampling crew handling the train or just one person may be listed on the train COC. The person recording the data will sign the COC for the sample when it reaches the sampling location. The person or persons transporting the sampling train to the sample recovery laboratory will sign the COC. When the sample train reaches the recovery laboratory, the laboratory chemist will check in the sample fractions, and sign the COC when the fractions are all received. In addition, the chemist will then begin a new COC when the fractions have been correctly recovered, labeled, and sealed.

The COC for the process samples will be filled out at the end of each performance run. Before that point, the samples will remain in the possession of the person collecting the samples. The samples may be secured in a cooler with the COC taped to the cooler until the performance run is completed. The samples will be secure because sample collection takes place in a high-security area. Personnel in the area must have a security clearance or be escorted by a security-cleared person before they are allowed within the double-fenced area. Only authorized personnel are allowed into the areas where the samples are held until shipment to the laboratory. Each person who has custody of the samples must sign the COC form, which must contain the following information:

- The sample identification number;
- The date and time of sample collection;
- The signature or initials of the sample collector;
- The matrix type;
- The number of containers;
- The signatures of persons in the COC; and
- The date and time of each change in custody.

7.3 SAMPLE TRANSPORT TO THE LABORATORY

Samples will be packaged and shipped according to U.S. Department of Transportation and EPA regulations and delivered to the laboratory so that the requested analyses can be performed within the specified allowable holding time. The samples will be accompanied by the COC record and by a sample analysis request form. The request form will list the variables to be analyzed by the laboratory and the total number and types of samples shipped for analysis. Authorized laboratory personnel will acknowledge receipt of shipment by signing and dating the COC form and returning a copy to the Field QC Officer.

8.0 SPECIFIC CALIBRATION PROCEDURES AND FREQUENCY

This section contains information and details pertaining to the calibration of both the process monitoring systems and the exhaust gas sampling equipment.

8.1 PROCESS MONITORING EQUIPMENT CALIBRATION

Process control instruments are calibrated on a regular basis as directed in the Instrument Calibration Plan (11). The calibration status of the LIC process control instruments at the time of the LIC Mustard ATB will be summarized in the final report. The calibrations will be conducted in accordance with the manufacturer's instructions. The monitoring equipment calibrated will be specified in the Appendix D tables (LIC AWFCO and operating condition target value tables). These instruments include:

- The PCC temperature transmitters;
- The SCC temperature transmitters;
- The venturi differential pressure;
- The brine flow meter;
- The clean liquor flow meter; and
- The pH meters.

Most of these instruments are on a regular schedule of calibration of every 180 to 360 days. The pH meters are on a weekly schedule for calibration. Temperature transmitters and weight measurements are calibrated every 90 days. The monitoring equipment calibrated is specified in the above mentioned tables in Appendix D.

8.2 EXHAUST GAS SAMPLING EQUIPMENT

The sampling subcontractor will calibrate the field sampling equipment before the LIC Mustard ATB and verify the calibration afterwards. When the STC arrives on site, they will provide copies of the calibration sheets to EG&G. The subcontractor will maintain an up-to-date list of sampling equipment, including serial numbers and pertinent calibration data. Posttest calibrations and equipment checks will be provided to EG&G before the subcontractor removes the equipment from the site. Calibration procedures will follow guidelines provided by EPA (12). The calibrations and checks will be performed as directed below:

- Probe Nozzles - Using a micrometer, measure the inside diameter of the nozzle to the nearest 0.001 inch (0.025 mm). Make measurements at three separate places across the diameter, and obtain the average of the measurements. The maximum difference should not exceed 0.004 inch (0.1 mm). Inspect for damage after sampling.
- Pitot Tubes - Measure for appropriate spacing and dimensions or calibrate in a wind tunnel. The rejection criteria are provided on the calibration sheet. Inspect for damage after sampling.
- Thermocouples - Verify against a mercury-in-glass thermometer at three points, including the anticipated measurement range. Acceptance limits are: impingers ± 2 °F, dry gas meter ± 5.4 °F, and duct ± 1.5 percent of the duct temperature.
- Dry Gas Meters - Calibrate in accordance with EPA Method 5 (6). Acceptance criteria: pre-test Yc: ± 5 percent of the calculated average Y.
- Balance - Service and certify annually by the manufacturer. Prior to obtaining first weights, confirm accuracy by placing a known S-type weight on the balance. Balances will be used for weighing the impingers and samples before sending them to the laboratory.

8.3 CALIBRATION OF CONTINUOUS EMISSION MONITORING SYSTEMS

System checks will be performed on each of the CEMS analyzers (O₂ and CO) on a daily basis. Detailed information on the calibration of the CEMS is available in Attachment 20 of the TOCDF RCRA Permit (5). The CO CEMS are calibrated weekly as directed by Attachment 20 (5). The O₂ CEMS are calibrated on a daily basis as directed by Attachment 20 (5). The CEMS operated by the sampling subcontractor will be calibrated before the LIC Mustard ATB and checked on a daily basis. Criteria for the daily check of the sampling subcontractor CEMS are summarized in Table A-8-1.

The ACAMS are designed to sample the exhaust gas on a continuous basis. (Operation of the ACAMS is discussed in Section 6.3.1.) The ACAMS will be challenged before and after each run. Detailed information on the operation of the ACAMS is available in TE-LOP-524 and Attachment 22 to the TOCDF RCRA Permit (8).

TABLE A-8-1. SUMMARY OF CEMS PERFORMANCE CHECK REQUIREMENTS

Criteria	Carbon Monoxide^a	Oxygen^a	Carbon Dioxide^b	Nitrogen Oxides^c	Sulfur Dioxide^c	Total Hydrocarbon Content^d
Calibration Drift (precision)	< 3% of span	< 0.5% reference	< 0.5% reference	< 3% of span	< 3% of span	< 3% of span
Calibration Error (accuracy)	< 5% of span	< 0.5% value	< 0.5% of span	< 2% of span	< 2% of span	< 5% of value
Response Time	≤ 2.0 min	≤ 2.0 min	≤ 2.0 min	NA	NA	≤ 2.0 min
Bias	NA	< 5% of span	< 5% of span	< 5% of span	< 5% of span	NA
Interference	NA	≤ 2% of span	≤ 2% of span	≤ 7% of span	≤ 7% of span	NA

Note: NA = Not Applicable

^a 40 CFR 266, Appendix IX, Section 2.1.

^b 40 CFR 60, Appendix B, Performance Specification 3.

^c 40 CFR 60, Appendix B, Performance Specification 2.

^d 40 CFR 266, Appendix IX, Section 2.2.

9.0 ANALYTICAL OBJECTIVES AND PROCEDURES

This section describes the analytical procedures to be used to analyze the samples collected during the LIC Mustard ATB. The analytical methods to be used include GC/FPD, GC with a Flame Ionization Detector (GC/FID), GC/MS, HRGC/HRMS, IC, Inductively Coupled Plasma (ICP) emission spectroscopy, ICP/Mass Spectrometer (ICP/MS), and Cold Vapor Atomic Absorption Spectroscopy (CVAAS). The QA procedures for this will follow the basic guidelines given in the methods or the QA/QC Handbook (4). Should a failure in the analytical system occur, the laboratory will notify the ATB subcontractor and EG&G immediately. Any corrective actions will be as directed by Annex A and EG&G. Table A-9-1 presents a summary of the analytical methods to be used.

The laboratories will prepare the sorbents (DAAMS tubes, Tenax®, Anasorb®-747, and XAD-2®) for gas sampling, prepare the QC samples, and analyze the samples. Laboratory QC samples will include method blanks, blank spikes (as calibration checks and LCS), matrix spikes, and replicates. These will be performed as required by the methods or at least one round of samples per batch and one round every twenty samples. The field blank will be a sampling train assembled in the field, leak checked, let stand for the sample time, and then recovered as other trains. Table A-9-2 lists the expected number of field samples, field blanks, and trip blanks to be analyzed.

Table A-9-2 assumes the following for:

- DAAMS samples - A set of four tubes collected every hour over the entire testing time and analyzed for mustard agent.
- Method 0031 (SMVOC) samples – Four sets of three tubes collected for 40 minutes for a total of 160 minutes, plus a field blank set per run and a trip blank pair for each shipment of samples. Analyses will be for VOCs.
- Method 0040 (VTOC) samples - One bag sample per run and a trip blank per run. Analyses will be for VTOC.
- Method 0010 samples - One set of samples per run plus one field blank per ATB. Analyses will be for SVOCs.
- Method 0010-TOC samples - One set of samples per run plus one field blank per ATB. Analyses will be for SVTOC and NVTOC.
- Method 0023A samples - One set of samples per run plus one field blank per ATB. Analyses will be for PCDDs/PCDFs.
- Method 29 samples - One set of samples per run plus one field blank per ATB. Analyses will be for the HHRA metals.

- Method 5/0050 samples - One set of samples per run plus one field blank per ATB. Analyses will be for PM, HF, HCl, and Cl₂.
- Slag samples - One sample of slag will be collected after the ATB. Slag samples will be analyzed for total mustard agent and HHRA metals. The slag will be evaluated using Method 1311 (1); the extract will be analyzed for TCLP metals.
- Liquid Samples – the Brine samples will be collected during the final 60 minutes of the run. A Decon sample will be collected for each run, but it may be collected before the run to allow an agent analyses to be conducted before the run. One duplicate set of Brine and Decon samples will be collected during one run. Samples of sodium hydroxide makeup and process water will be collected once per ATB. The Brine samples will be analyzed for agent before the samples can be sent off-site, and the liquid samples will be analyzed for total HHRA metals, VOCs, and SVOCs.

TABLE A-9-1. ANALYTICAL METHODS

Parameter	Matrix	Preparation	Analysis Method
Agent	DAAMS Tubes	TE-LOP-562	TE-LOP-562
VOCs	Tenax®, Anasorb®-747, SMVOC Condensate	Method 5041A	Method 5041A/8260B
VTOC	Bag/Condensate	None-Bag/5030A-Condensate	GC/FID
SVOCs	XAD-2®/filter/condensate/rinseate	Method 3542	Method 8270C
SVTOC/NVTOC	XAD-2®/filter/condensate/rinseate	Method 3542	GC/FID and Gravimetric
PCDDs/PCDFs	XAD-2®/filter/rinseate	Method 0023A	Method 0023A/8290
Particulate Matter (PM)	Filter/rinse	Method 5	Method 5
HF, HCl, and Cl ₂	Impinger solutions	Method 0050	Method 9057
HHRA Metals	Filter, rinseate, impinger solution	Method 29	Methods 6020 and 7470A
Agent	Brine/Decon/slag	TE-LOP-572	TE-LOP-572
Agent Purity/Impurities	Neat agent	TE-LOP-584	TE-LOP-584
HHRA Metals	Neat agent	TE-LOP-584	TE-LOP-557
VOCs	Brine/Decon/water/slag	Method 5030B	Method 8260B
SVOCs	Brine/Decon/water	Method 3510C and 3540C for slag	Method 8270C
PCDDs/PCDFs	Brine	Method 8290	Method 8290
PCBs	Brine	Method 3510C	Mod. Method 1668
HHRA Metals	Brine/Decon/water/slag	Method 3010A/3051/ 7470A/ 7471A	Method 6010B/6020/ 7470A/7471A
TCLP Metals	Slag	Method 1311/3010A/7470A	Method 6010B/6020/7470A

TABLE A-9-2. NUMBER OF SAMPLES

Sample	LIC ATB	Field Duplicate	Field Blank	Trip Blank
DAAMS sets	15	0	3	3
Method 0031	12	0	3	3
Method 0040	3	0	3	2
Method 0010-SVOC	3	0	1	0
Method 0010-SVTOC/NVTOC	3	0	1	0
Method 0023A	3	0	1	0
Method 5/0050	3	0	1	0
Method 29	3	0	1	0
Slag	1	0	0	0
Wet Scrubber Recirculation Brine	3	1	0	0
Decon	3	1	0	0
NaOH Makeup	1	0	0	0
Process Water	1	0	0	0
Neat Mustard	3	1	0	0

Method blanks, blank spikes, matrix spikes, and replicates will be performed according to the methods.

9.1 ANALYSIS METHODS FOR PROCESS STREAM SAMPLES

Process samples collected include neat agent, slag, Brine, Decon, process water and NaOH makeup. Process water, NaOH makeup, and slag will be sampled once during the LIC Mustard ATB. The other process samples will be sampled for each run.

9.1.1 Agent Analysis Method

Samples of the Brine, Decon, and slag must be screened for mustard agent before the samples can leave the facility. The method used for this analysis is TE-LOP-572, which uses chloroform to extract the agent. An aliquot of the extract is injected into a GC/FPD, where the agent is separated from any other compounds, and the sulfur in the mustard agent is detected.

9.1.2 pH Analysis

The pH of Brine samples will be determined with a pH probe and pH meter using TE-LOP-574. The pH probe and meter are calibrated using standards, then the pH probe is rinsed, dried, and placed in the solution to be analyzed. The pH reading is recorded, and the probe is removed from the solution, rinsed with distilled or DI water, and dried. The probe is then ready for the next measurement.

9.1.3 Inorganic Analysis Methods

The process samples inorganic analyses are limited to the metals present in the samples. Mercury will be analyzed by SW-846, Methods 7470A or 7471A (1), which use CVAAS. The remaining HHRA metals are analyzed by ICP or ICP/MS. The slag sample will be evaluated using the TCLP. Table A-9-3 lists the elements to be analyzed by analysis method for the process samples. The methods are described below.

- **SW-846 Method 6010B - ICP - Atomic Emissions Spectroscopy.** The most recent version of this method will be used. A representative portion of the sample is digested with nitric acid using SW-846, Method 3010A, for liquids and SW-846, 3051, for slag samples (1). The sample digest is aspirated into the nebulizer of the ICP spectrometer, and the emission for each analytical element determined. Quantitation is achieved by comparison of sample responses to the responses of internal standards.

**TABLE A-9-3. TOCDF METALS TARGET ANALYTE LIST
FOR PROCESS SAMPLES**

Element		Aqueous Sample Analyses Method	Residue Total Analyses Method	TCLP Extract Analyses Method
1	Aluminum	6010	6010	NA
2	Antimony	6020	6020	6020
3	Arsenic	6020	6020	6020
4	Barium	6010	6010	6010
5	Beryllium	6010	6010	6010
6	Boron	6010	6010	NA
7	Cadmium	6010	6010	6020
8	Chromium (Total)	6010	6010	6020
9	Cobalt	6010	6010	NA
10	Copper	6010	6010	NA
11	Lead	6020	6020	6020
12	Manganese	6010	6010	NA
13	Mercury	7470A	7471A	7470A
14	Nickel	6010	6010	6010
15	Selenium	6020	6020	6020
16	Silver	6010	6010	6020
17	Thallium	6020	6020	6020
18	Tin	6010	6010	NA
19	Vanadium	6010	6010	6010
20	Zinc	6010	6010	6010

Note:

NA = This element is not analyzed in this matrix.

Analytes may be analyzed by Method 6020 instead of 6010.

- **SW-846 Method 6020 – ICP/MS.** Selected metals concentrations in the process samples will be determined by ICP/MS. (The most recent version of the method will be used.) A representative portion of the sample is digested with nitric acid and the sample digest is aspirated into the nebulizer of the ICP/MS. The sample mist enters the plasma, the plasma converts the sample to an atomic vapor, and the mass spectrometer separates the elements by mass. The masses detected are used to quantitate the elements present by comparing sample responses to the responses of internal standards.
- **SW-846 Method 7470A (liquids) and 7471A (solids) - Manual Cold-Vapor Technique.** A representative portion of the sample is digested with acids, potassium permanganate, and potassium persulfate. Mercury ions are reduced to metallic mercury and stripped from the aqueous solution with a gas stream. The mercury vapors are then directed into the path of an atomic absorption spectrometer. Quantitation is achieved by comparison of sample component responses to the responses of external standards.

9.1.4 Organic Compound Analysis Methods

Brine, Decon, process water, and NaOH makeup samples will be analyzed for VOCs and SVOCs using the most recent versions of Methods 8260B and 8270C, respectively. The Brine and Decon samples will also be analyzed for PCDDs/PCDFs and PCBs. These methods are described below, and their performance will be evaluated using the criteria listed in the QA/QC tables found in Annex A.

SW-846 Method 8260B - Volatile Organic Compounds by GC/MS. Samples of the slag will be added to a water miscible solvent to dissolve the VOCs and an aliquot is placed in the purging vessel as directed by SW-846, Method 5030B (1). A representative portion of the liquid samples is introduced into a purge device using SW-846, Method 5030B (1). The liquid is purged with an inert gas, and the volatile compounds are collected on a sorbent trap. The trap is then heated and backflushed to desorb the compounds into the GC/MS. The sample is then analyzed for the Target Analyte List shown in Table A-9-4 using SW-846, Method 8260B (1). Quantitation is achieved by comparison of sample component responses to the responses of internal standards.

SW-846 Method 8270C - Semi-Volatile Organic Compounds by GC/MS. Aqueous samples have a representative aliquot of the sample extracted by SW-846, Method 3510B (1), using methylene chloride and then concentrated to a known volume. Slag samples have an aliquot extracted using SW-846, Method 3540C which uses soxhlet extraction with methylene chloride and then the extract is evaporated to a known volume. Aliquots of the extracts are analyzed by SW-846, Method 8270 (1), using GC/MS. Quantitation is achieved by comparison of sample component responses to the responses of internal standards. Table A-9-5 lists the target analytes for the total SVOC analyses.

TABLE A-9-4. TOTAL VOC TARGET ANALYTE LIST FOR PROCESS SAMPLES

1	Acetone	29	1,2-Dichloropropane
2	Benzene	30	1,3-Dichloropropane
3	Bromobenzene	31	2,2-Dichloropropane
4	Bromochloromethane	32	1,1-Dichloropropene
5	Bromodichloromethane	33	<i>cis</i> -1,3-Dichloropropylene
6	Bromomethane	34	<i>trans</i> -1,3-Dichloropropylene
7	2-Butanone	35	1,4-Dioxane
8	Carbon Disulfide	36	Ethylbenzene
9	Carbon tetrachloride	37	n-Hexane
10	Chlorobenzene	38	2-Hexanone
11	2-Chloro-1,3-butadiene	39	Iodomethane
12	Chlorodibromomethane	40	Methylene chloride
13	Chloroethane	41	Methyl isobutyl ketone
14	Chloroform	42	n-Propylbenzene
15	2-Chloroethyl vinyl ether	43	Styrene
16	Chloromethane	44	1,1,1,2-Tetrachloroethane
17	2-Chlorotoluene	45	1,1,2,2-Tetrachloroethane
18	4-Chlorotoluene	46	Tetrachloroethylene
19	Cumene (isopropylbenzene)	47	Toluene
20	1,2-Dibromoethane	48	Tribromomethane (Bromoform)
21	Dibromomethane	49	1,1,1-Trichloroethane
22	<i>trans</i> -1,4-Dichloro-2-butene	50	1,1,2-Trichloroethane
23	Dichlorodifluoromethane	51	Trichloroethylene
24	1,1-Dichloroethane	52	Trichlorofluoromethane
25	1,2-Dichloroethane	53	1,2,3-Trichloropropane
26	1,1-Dichloroethylene	54	1,1,2-Trichloro-1,2,2-trifluoroethane
27	<i>cis</i> -1,2-Dichloroethylene	55	Vinyl chloride
28	<i>trans</i> -1,2-Dichloroethylene	56	Xylenes(o-, m-, p-)

**TABLE A-9-5. TOTAL SVOC TARGET ANALYTE LIST
FOR PROCESS SAMPLES**

1	Acenaphthylene	35	1,4-Dinitrobenzene
2	Acenaphthene	36	4,6-Dinitro-o-cresol
3	Acetophenone	37	2,4-Dinitrophenol
4	Aniline	38	2,4-Dinitrotoluene
5	Anthracene	39	2,6- Dinitrotoluene
6	Benz(a)anthracene	40	Di-n-octyl phthalate
7	Benzo(b)fluoranthene	41	Diphenylamine
8	Benzo(k)fluoranthene	42	Fluoranthene
9	Benzo(g,h,i)perylene	43	Fluorene
10	Benzo(a)pyrene	44	Hexachlorobenzene
11	4-Bromophenyl phenyl ether	45	Hexachlorobutadiene
12	Butyl benzyl phthalate	46	Hexachlorocyclopentadiene
13	p-Chloroaniline	47	Hexachloroethane
14	Chlorobenzilate	48	Indeno(1,2,3-c,d) pyrene
15	<i>Bis</i> (2-Chloroethoxy)methane	49	Naphthalene
16	<i>Bis</i> (2-Chloroethyl)ether	50	2-Naphthylamine
17	<i>Bis</i> (2-Chloroisopropyl) ether	51	2-Nitroaniline
18	4-Chloro-3-methylphenol	52	4-Nitroaniline
19	2-Chloronaphthalene	53	Nitrobenzene
20	2-Chlorophenol	54	2-Nitrophenol
21	Chrysene	55	4-Nitrophenol
22	o-Cresol	56	Pentachlorobenzene
23	m-Cresol	57	Pentachloroethane
24	p-Cresol	58	Pentachloronitrobenzene
25	Dibenz(a,h)anthracene	59	Pentachlorophenol
26	m-Dichlorobenzene	60	Phenanthrene
27	o-Dichlorobenzene	61	Phenol
28	p-Dichlorobenzene	62	Pyrene
29	2,4-Dichlorophenol	63	1,2,4,5-Tetrachlorobenzene
30	2,6-Dichlorophenol	64	2,3,4,6-Tetrachlorophenol
31	Diethyl phthalate	65	1,2,4-Trichlorobenzene
32	2,4-Dimethyl phenol	66	2,4,5-Trichlorophenol
33	Dimethyl phthalate	67	2,4,6-Trichlorophenol
34	Di-n-butyl phthalate		

Modified Method 1668 – PCBs by HRGC/HRMS. Brine and slag samples will be analyzed for Co-planar PCBs and total PCBs using a modification of EPA Draft Method 1668. Method 1668 uses a HRGC/HRMS to analyze for the toxic PCB congeners. To determine an accurate concentration of the PCBs present in the post-combustion samples, it is necessary to prepare a concentration based on the summation of homologues to provide a total of all PCBs present which requires the use of a HRGC/HRMS. Table A-9-6 lists the PCB target analyte list.

The samples are extracted with toluene and evaporated to a known volume. The extracts are subjected to a series of cleanup steps before the samples are analyzed. Carbon-13 internal standards are used for each Homologous series with the exception of the nonachlorobiphenyls, which use the Carbon-13, decachlorobiphenyl. Internal standard recoveries and surrogate recoveries will be reported with each sample. The Co-planar PCBs results will be used in calculation of the Toxic Equivalent Concentration for tetrachlorodibenzo-p-dioxin.

Two main modifications were made to Method 1668. The first modification was to expand the homologues monitored from four to ten. The toxic PCB congeners are found in the tetrachloro- to heptachloro- homologues. The modification involves monitoring the additional masses of the other homologues during their respective retention times. Expanding the homologues monitored will not impair the ability to analyze the toxic PCB congeners. Monitoring would be set to begin with the chlorobiphenyls and continue until decachlorobiphenyl elutes from the system. The second change is the use of a 60-meter column in place of the two 30-meter columns suggested in the method. The use of one 60-meter column will allow separation of the congeners of concern in one injection.

SW-846 Method 8290 – PCDDs/PCDFs by HRGC/HRMS. A representative sample is extracted with toluene, the extract is then concentrated to a known volume, and the extract is subjected to a series of cleanup steps. The sample is then evaporated to a small volume and diluted to a known volume. An aliquot of the cleaned extract is then injected into a HRGC/HRMS and the compounds quantitated against internal standards.

TABLE A-9-6. MODIFIED METHOD 1668 TARGET ANALYTE LIST

PCB HOMOLOGUES	SPECIFIC PCB CONGENERS
Total Monochlorobiphenyls	PCB #77 - 3,3',4,4'-Tetrachlorobiphenyl
Total Dichlorobiphenyls	PCB #81 - 3,4,4',5-Tetrachlorobiphenyl
Total Trichlorobiphenyls	PCB #105 - 2,3,3',4,4'-Pentachlorobiphenyl
Total Tetrachlorobiphenyls	PCB #114 - 2,3,4,4',5-Pentachlorobiphenyl
Total Pentachlorobiphenyls	PCB #118 - 2,3',4,4',5-Pentachlorobiphenyl
Total Hexachlorobiphenyls	PCB #123 - 2,3',4,4',5'-Pentachlorobiphenyl
Total Heptachlorobiphenyls	PCB #126 - 3,3',4,4',5-Pentachlorobiphenyl
Total Octachlorobiphenyls	PCB #156 - 2,3,3',4,4',5-Hexachlorobiphenyl
Total Nonachlorobiphenyls	PCB #157 - 2,3,3',4,4',5'-Hexachlorobiphenyl
Decachlorobiphenyl	PCB #167 - 2,3',4,4',5,5'-Hexachlorobiphenyl
	PCB #169 - 3,3',4,4',5,5'-Hexachlorobiphenyl
	PCB #170 - 2,2',3,3',4,4',5-Heptachlorobiphenyl
	PCB #180 - 2,2',3,4,4',5,5'-Heptachlorobiphenyl
	PCB #189 - 2,3,3',4,4',5,5'-Heptachlorobiphenyl

9.1.5 Agent Characterization Methods

Agent samples collected are evaluated for agent purity, organic compound impurities, and HHRA metals. The target analyte list for the characterization of mustard agent is shown in Table A-9-7. The agent purity and the organic compound impurities are analyzed by the CAL using method TE-LOP-584. Sample aliquots are weighed and then diluted with isopropyl alcohol to a known volume. The diluted samples are analyzed using GC/MS. The compounds present are quantitated against internal standards.

The HHRA metals present in the neat mustard agent are analyzed by ICP/MS using TE-LOP-557. The agent samples are prepared for analysis using TE-LOP-584 by digesting an aliquot of mustard agent in a combination of hydrochloric acid and nitric acid and heating in a microwave oven. The digested sample is then diluted to a known volume and analyzed by aspirating the solution into the plasma which produces an atomic vapor. The mass spectrometer separates the elements by their mass. The elements are quantitated against internal standards.

TABLE A-9-7. TARGET ANALYTE LIST FOR MUSTARD AGENT

Analyte	Analysis Method
Mustard or <i>Bis</i> (2-chloroethyl)sulfide	TE-LOP-584
<i>Bis</i> [2-(2-chloroethylthio)ethyl]ether (T)	TE-LOP-584
1,2- <i>Bis</i> (2-chloroethylthio)ethane (Q)	TE-LOP-584
1,2-Dichloroethane	TE-LOP-584
1-(2-Chloroethoxy)-2-(2-chloroethylthio) ethane	TE-LOP-584
2-Chloroethyl chlorobutyl sulfide (mixed isomers)	TE-LOP-584
1,4-Dithiane	TE-LOP-584
1,4-Thioxane	TE-LOP-584
HHRA Metals	TE-LOP-557

9.2 ANALYSIS METHODS FOR EXHAUST GAS SAMPLES

9.2.1 Analysis of DAAMS Tubes

The DAAMS tubes are analyzed using TE-LOP-562. This method uses thermal desorption of the organic compounds into a GC/FPD. The organic compounds are separated from the mustard agent by the GC analytical column. A photomultiplier tube detects light emitted by the sulfur in the mustard agent which burns in a flame as it elutes from the column. The detector response is compared to external standards for quantitation. Method performance will be evaluated using the criteria listed in the QA/QC tables found in Annex A.

Four DAAMS tubes are collected in each set. One tube will be spiked with mustard agent to act as a field surrogate for the sampling method. The other three tubes will be analyzed in the following order:

- The A tube will be analyzed first; if no mustard agent is found in the A tube, no further analyses will be conducted on this set of DAAMS tubes, and the PQL will be used in the calculation of a concentration.
- If mustard agent is found on the A tube, then the B tube will be analyzed; if no mustard agent is found on the B tube, then no further analyses will be conducted, and the PQL will be used to calculate the concentration.
- If agent is found in the B tube, then the B tube value will be used to calculate the concentration.
- If no mustard agent is found on the B tube, then the presence of mustard agent will not be confirmed.
- The C tube will be reserved for GC/MS analysis or used if either the A or B tubes are lost. The C tube may also be used if additional analyses are required.

9.2.2 Analysis of SMVOC Tubes

The samples collected from each SMVOC set will consist of two Tenax® tubes and an Anasorb®-747 tube. The two Tenax® tubes will be desorbed as one sample, and each Anasorb®-747 tube will be analyzed as a separate sample. The tubes will be analyzed for VOCs by thermal desorption and subsequent analysis by GC/MS, using Method 5041A (1). The organic compounds in the sample will be thermally desorbed into water using a carrier gas. The desorbed compounds will then be purged from the water and collected on an analytical trap containing Tenax® and other GC-column packing materials. The compounds will be desorbed off the trap into the GC/MS.

Selected compounds are spiked into various parts of the Method 5041A analysis apparatus, and spiking locations are specified by Method 0031 (1). For Method 5041A, the following compounds are specified:

<u>Application</u>	<u>Compounds</u>	<u>Spiking Location</u>
Surrogates	Dibromofluoromethane, Bromofluorobenzene, 1,2-Dichloroethane-d ₄ , and Toluene-d ₈	Tenax® tube
Internal Standards	Bromochloromethane, Chlorobenzene-d ₅ , and 1,4-Difluorobenzene	Purge Vessel
LCS	1,1-Dichloroethene, Benzene, Chlorobenzene, Toluene, and Trichloroethene	Tenax® tube
MS/MSD for Condensate Samples	1,1-Dichloroethene, Benzene, Chlorobenzene, Toluene, and Trichloroethene	Purge Vessel

Sample breakthrough will be checked by analyzing the two Tenax® tubes separately from the Anasorb®-747 tube. Breakthrough will be defined as 30 percent or greater on the Anasorb®-747 tube relative to the two Tenax® tubes. This criterion will not apply if 75 ng or less is detected on the Anasorb®-747 tube. The analysis results of the two Tenax® tubes and the Anasorb®-747 tube will be summed for subsequent emission calculations.

The VOCs determined by Method 5041A (1) will be identified as PICs. Table A-9-8 is the Target Analyte List for the VOCs. The method for analysis of the Tenax® tubes is calibrated with standards for the 56 compounds listed in Table A-9-8. The method of analysis for the Anasorb®-747 tubes is calibrated for the 31 compounds marked in Table A-9-8.

The compounds not analyzed on the Anasorb®-747 tubes are not quantitatively desorbed from the Anasorb®-747 tubes. These compounds will be collected on the Tenax® tubes. The final VOC concentrations will be a summation of the analyses from the Tenax® tube pairs, the Anasorb®-747 tubes and the condensate sample. The 20 largest additional peaks, with an area at least 10% of the internal standards, will be tentatively identified from each analyses conducted and will be classified as Tentatively Identified Compounds (TICs). Performance of this method will be evaluated using the criteria listed in the QA/QC tables found in Annex A.

**TABLE A-9-8. VOLATILE ORGANIC COMPOUND TARGET ANALYTE
LIST FOR METHOD 5041A**

Acetone	<i>trans</i> -1,2-Dichloroethene *
Benzene *	1,2-Dichloropropane *
Bromobenzene	1,3-Dichloropropane
Bromochloromethane *	2,2-Dichloropropane
Bromodichloromethane *	1,1-Dichloropropene *
Bromoform	<i>cis</i> -1,3-Dichloropropene *
Bromomethane *	<i>trans</i> -1,3-Dichloropropene *
2-Butanone	Ethylbenzene
Carbon disulfide *	n-Hexane
Carbon tetrachloride *	2-Hexanone
Chlorobenzene *	Iodomethane
Chloroethane *	Methylene chloride *
Chloroform *	4-Methyl-2-pentanone
Chloromethane *	n-Propylbenzene
2-Chloropropane *	Styrene
2-Chlorotoluene	1,1,1,2-Tetrachloroethane
4-Chlorotoluene	1,1,2,2-Tetrachloroethane
Cumene	Tetrachloroethene *
Dibromochloromethane	Toluene *
1,2-Dibromoethane	1,1,1-Trichloroethane*
Dibromomethane *	1,1,2-Trichloroethane *
<i>cis</i> -1,4-Dichloro-2-butene	Trichloroethene *
<i>trans</i> -1,4-Dichloro-2-butene	Trichlorofluoromethane *
Dichlorodifluoromethane *	1,2,3-Trichloropropane
1,1-Dichloroethane *	1,1,2-Trichloro-1,2,2-trifluoroethane *
1,2-Dichloroethane *	Vinyl chloride *
1,1-Dichloroethene *	m,p-Xylene
<i>cis</i> -1,2-Dichloroethene *	o-Xylene

* These compounds will be analyzed on the Anasorb®-747 tubes.

9.2.3 Analysis of Method 0040 Samples for VTOC

Samples of exhaust gas in Tedlar bags are analyzed by GC/FID as directed by EPA Guidance (7). The bag is attached to the gas sampling valve of the GC and the sample is drawn into the sample loop. The sample in the sample loop is allowed to reach atmospheric pressure. The gas sampling valve is then actuated, flushing the sample into the GC. The GC column separates the compounds and the chromatogram and areas under the peaks are recorded. A calibration curve is established and a calibration verification sample is run daily. The concentration of VTOC is calculated from the detected area using the calibration curve. Two sample aliquots are analyzed as a minimum.

9.2.4 Analysis of Method 0010 Samples for SVOCs

The filter, XAD-2® resin, impinger contents, and rinses will be extracted with methylene chloride and evaporated to a known volume. The extracts will then be analyzed by Method 8270C (1). An aliquot of the extract is injected into a GC/MS. The column separates the compounds, and the mass spectrometer detects the compounds as they elute from the column. A mass spectrometer allows the compound's mass spectra to be compared to the spectra of a standard compound for identification of the sample compound.

Surrogate and internal standards are used to measure the performance of the sample preparation and analyses. Spiking locations are specified by Method 3542 (1). Surrogate standards for the front-half sample are spiked onto the filter before the filter is placed in the extraction device. The back-half surrogate standards are spiked onto the XAD-2 resin after the resin is placed in the extraction device. The condensate samples surrogate standards are spiked into the samples after they have been transferred to separatory funnels. Internal standards are spiked into the sample vial just before the samples are analyzed. For Method 8270C, the following standards are specified:

STANDARDS	COMPOUNDS
Surrogate Standards	2,4,6-Tribromophenol, 2-Fluorobiphenyl, 2-Fluorophenol, Nitrobenzene-d ₅ , Phenol-d ₅ , and Terphenyl-d ₁₄
Internal Standards	1,4-Dichlorobenzene-d ₄ , Naphthalene-d ₈ , Perylene-d ₁₂ , Acenaphthene-d ₁₀ , Phenanthrene-d ₁₀ , and Chrysene-d ₁₂

Method 8270C reports analyses for the 133 compounds listed in Table A-9-9. These compounds are a tentative list of PICs. The 20 largest additional peaks, with an area at least 10% of the internal standards, will be tentatively identified and classified as TICs. Performance of the method will be evaluated using the criteria listed in the QA/QC tables in Annex A.

9.2.5 Analysis of Method 0010 Samples for SVTOC and NVTOC

Samples are recovered according to SW-846, Method 3542. The sample extracts are combined and evaporated to near dryness. The extract is then diluted to a known volume and the sample divided into two fractions. The one fraction is analyzed by GC/FID for SVTOC, while the second fraction is evaporated to dryness to determine the NVTOC.

The GC/FID method determines the concentration of compounds with boiling points between 100 °C and 300 °C. An aliquot of the sample extract is placed in an autosampler vial. An aliquot is then injected into the GC, which separates the compounds present in the sample and allows the peak areas in the method window to be summed to give a total mass. The concentration is determined using a calibration curve.

A sample aliquot of 5 mL or less is added to a cleaned dish. The dish is then placed in a clean fume hood and evaporated to dryness at room temperature. The dried sample pan is placed in a desiccator for a minimum of eight hours. The sample is then weighed at four hour intervals until three weighings agree to ± 0.03 mg.

TABLE A-9-9. SEMI-VOLATILE ORGANIC COMPOUND TARGET ANALYTE LIST

Acenaphthene	4-Bromophenyl phenyl ether
Acenaphthylene	Butyl benzyl phthalate
Acetophenone	2-sec-Butyl-4,6-dinitrophenol
2-Acetylaminofluorene	4-Chloroaniline
4-Aminobiphenyl	Chlorobenzilate
3-Amino-9-ethylcarbazole ^a	4-Chloro-3-methylphenol
Aniline	1-Chloronaphthalene
Anthracene	2-Chloronaphthalene
Aramite	2-Chlorophenol
Benzidine	4-Chlorophenyl phenyl ether
Benzoic acid	Chrysene
Benz(a)anthracene	4-4'-DDE ^a
Benzo(b)fluoranthene	Diallate (cis or trans)
Benzo(j)fluoranthene	Dibenz(a,j)acridine
Benzo(k)fluoranthene	Dibenz(a,h)anthracene
Benzo(g,h,i)perylene	Dibenzofuran
Benzo(a)pyrene	1,2-Dibromo-3-chloropropane ^a
Benzo(e)pyrene	Di-n-butyl phthalate
Benzyl alcohol	1,2-Dichlorobenzene
Benzaldehyde	1,3-Dichlorobenzene
Benzenethiol ^a	1,4-Dichlorobenzene
Biphenyl	3,3'-Dichlorobenzidine
Bis(2-chloroethoxy)methane	2,4-Dichlorophenol
Bis(2-chloroethyl)ether	2,6-Dichlorophenol
Bis(2-chloroisopropyl)ether	Diethyl phthalate
Bis(2-ethylhexyl)phthalate	Dihydrosafrole ^a

**TABLE A-9-9. SEMI-VOLATILE ORGANIC COMPOUND TARGET ANALYTE LIST
(continued)**

p-(Dimethylamino)azobenzene	Isophorone
7,12-Dimethylbenz(a)anthracene	Isosafrole
3,3'-Dimethylbenzidine	Methoxychlor ^a
α,α ,-Dimethylphenethylamine	Methyl cyclohexane ^a
2,4-Dimethyl phenol	3-Methylcholanthrene
Dimethyl phthalate	Methyl methanesulfonate
1,3-Dinitrobenzene	2-Methylnaphthalene
4,6-Dinitro-2-methylphenol	2-Methyl-5-nitroaniline
2,4-Dinitrophenol	2-Methylphenol
2,4-Dinitrotoluene	3-Methylphenol
2,6-Dinitrotoluene	4-Methylphenol
Dioxathion ^a	Naphthalene
Diphenylamine	1,4-Naphthoquinone
1,2-Diphenylhydrazine ^b	1-Naphthylamine
Di-n-octyl phthalate	2-Naphthylamine
Ethyl methanesulfonate	5-Nitroacenaphthene ^a
Ethyl parathion	2-Nitroaniline
Fluoranthene	3-Nitroaniline
Fluorene	4-Nitroaniline
Heptachlor ^a	Nitrobenzene
Hexachlorobenzene	2-Nitrophenol
Hexachlorobutadiene	4-Nitrophenol
Hexachlorocyclopentadiene	4-Nitroquinoline-1-oxide
Hexachloroethane	N-Nitrosodibutylamine
Hexachloropropene	N-Nitrosodiethylamine
Indeno(1,2,3-cd)pyrene	N-Nitrosodimethylamine

**TABLE A-9-9. SEMI-VOLATILE ORGANIC COMPOUND TARGET ANALYTE LIST
(continued)**

N-Nitrosomethylethylamine	Pronamide
N-Nitrosodiphenylamine ^c	Pyrene
N-Nitroso-di-n-propylamine	Pyridine
N-Nitrosomorpholine	Quinoline ^a
N-Nitrosopiperidine	Safrole
N-Nitrosopyrrolidine	1,2,4,5-Tetrachlorobenzene
Pentachlorobenzene	2,3,4,6-Tetrachlorophenol
Pentachloroethane	o-Toluidine
Pentachloronitrobenzene	p-Toluidine ^a
Pentachlorophenol	Tributylamine ^a
Phenacetin	1,2,4-Trichlorobenzene
Phenanthrene	2,4,5-Trichlorophenol
Phenol	2,4,6-Trichlorophenol
1,4-Phenylenediamine	1,3,5-Trinitrobenzene
2-Picoline (2-Methylpyridine)	

^a Response factor is based on the closest eluting internal standard with the compound identity confirmed by library searches.

^b Laboratory quantifies as diphenylamine. 1,2-diphenylhydrazine will be analyzed as azobenzene

^c N-Nitrosodiphenylamine decomposes to diphenylamine.

9.2.6 Analysis of Method 0023A Samples for PCDDs/PCDFs

The filter, XAD-2® resin, and the impinger rinses will be extracted with toluene and evaporated to a known volume. Then, the extract will be subjected to a series of cleanup procedures to remove interferences. The final extract will be analyzed for PCDDs/PCDFs using Methods 0023A/8290 (1). An aliquot of the cleaned extract is injected into a HRGC/HRMS, and quantitation is achieved by comparison to internal standards.

The Method 0023A train is recovered into four containers that are subsequently combined into two fractions. Surrogates are spiked onto the XAD-2® resin before the samples are collected for the back-half fraction. Surrogates for the front-half fraction are spiked onto the filter just before the filter is placed in the extraction thimble. The front-half fraction internal standards are spiked onto the filter after it has been placed in the extraction thimble. The back-half fraction internal standards are spiked onto the XAD-2® resin after the resin has been transferred to the extraction device. Method 0023A/8290 (1) specifies the following standards:

STANDARD	COMPOUNDS
Surrogate Standards	³⁷ Cl ₄ -2,3,7,8-TCDD, ¹³ C ₁₂ -1,2,3,4,7,8-HxCDD, ¹³ C ₁₂ -2,3,4,7,8-PeCDF, ¹³ C ₁₂ -1,2,3,4,7,8-HxCDF, ¹³ C ₁₂ -1,2,3,4,7,8,9-HpCDF
Internal Standards	¹³ C ₁₂ -2,3,7,8-TCDD, ¹³ C ₁₂ -1,2,3,7,8-PeCDD, ¹³ C ₁₂ -1,2,3,6,7,8-HxCDD, ¹³ C ₁₂ -1,2,3,4,6,7,8-HpCDD, ¹³ C ₁₂ -OCDD, ¹³ C ₁₂ -2,3,7,8-TCDF, ¹³ C ₁₂ -1,2,3,7,8-PeCDF, ¹³ C ₁₂ -1,2,3,6,7,8-HxCDF, ¹³ C ₁₂ -1,2,3,4,6,7,8-HpCDF

Table A-9-10 shows the target analyte list for this method. Performance of the method will be evaluated using the criteria listed in the QA/QC tables found in Annex A.

TABLE A-9-10. PCDD/PCDF TARGET ANALYTE LIST

Polychlorinated Dibenzo-P-Dioxins	Polychlorinated Dibenzofurans
2,3,7,8-TCDD	2,3,7,8-TCDF
Total TCDDs	Total TCDFs
1,2,3,7,8-PeCDD	1,2,3,7,8-PeCDF
Total PeCDDs	2,3,4,7,8-PeCDF
1,2,3,4,7,8-HxCDD	Total PeCDFs
1,2,3,6,7,8-HxCDD	1,2,3,4,7,8-HxCDF
1,2,3,7,8,9-HxCDD	1,2,3,6,7,8-HxCDF
Total HxCDDs	2,3,4,6,7,8-HxCDF
1,2,3,4,6,7,8-HpCDD	1,2,3,7,8,9-HxCDF
Total HpCDDs	Total HxCDFs
Octachlorodibenzo-p-dioxin	1,2,3,4,6,7,8-HpCDF
	1,2,3,4,7,8,9-HpCDF
	Total HpCDFs
	Octachlorodibenzofuran

9.2.7 Analysis of Metals Emissions

The Method 29 samples will be analyzed for the HHRA metals and are listed in Table A-9-11. The samples will be prepared as described in Method 29 (6). Mercury will be analyzed by CVAAS using Method 7470A and is discussed in Section 9.1.3. The remaining elements will be analyzed by ICP/MS using SW-846, Method 6020 (1), which was modified by the addition of tin and vanadium to the analyte list.

SW-846 Method 6020 – ICP/MS. Metals concentrations in the Method 29 samples will be determined by ICP/MS. (The most recent version of the method will be used.) A representative portion of the sample is digested with nitric acid and the sample digest is aspirated into the nebulizer of the ICP/MS. The sample mist enters the plasma, the plasma converts the sample to an atomic vapor, and the mass spectrometer separates the elements by mass. The masses detected are used to quantitate the elements present. Quantitation is achieved by comparison of sample responses to the responses of internal standards.

Performance of the method will be evaluated using the criteria listed in the QA/QC tables found in Annex A.

9.2.8 Analysis of Halogen Emissions

The analysis of HF, HCl, and Cl₂ in the exhaust gas impinger samples will be performed by IC using Method 9057 (1). This method separates the anions by ion chromatography and the eluting anions are detected. The HF and HCl emissions are determined from the analysis of the sulfuric acid impingers, and Cl₂ emissions are determined from the analysis of the NaOH impingers using IC. Concentrations are calculated based on external calibration standards. Performance of the method will be evaluated using the criteria listed in the QA/QC tables found in Annex A.

9.2.9 Particulate Matter Analysis

The probe rinse and the filter of the combined Method 5/0050 (6) train will be used to determine the PM concentrations. The probe rinse and filter will be dried and desiccated to a constant weight as directed in Method 5 (6).

TABLE A-9-11. METHOD 29 TARGET ANALYTE LIST

Analyte	Analyte
Aluminum	Lead
Antimony	Manganese
Arsenic	Mercury
Barium	Nickel
Beryllium	Selenium
Boron	Silver
Cadmium	Thallium
Chromium	Tin
Cobalt	Vanadium
Copper	Zinc

10.0 SPECIFIC LABORATORY QUALITY CONTROL CHECKS

The QC checks are performed to ensure the collection of representative samples and the generation of valid analytical results on these samples. The project participants will perform QC checks throughout the program. The laboratories will utilize EPA-approved analytical methods for those analytes that have methods available. In addition, standard Army methods will be used for the mustard agent analyses. The QC samples analyzed will include method blanks, duplicate samples, LCS, and MS/MSD. Table A-9-2 lists the field blanks to be collected.

Reagents used in the laboratory are normally of analytical reagent grade, or higher purity; each lot of acid or solvent used is checked for acceptability prior to laboratory use. All reagents are labeled with the date received and the date opened. The quality of the laboratory DI water is routinely checked. The glassware used in the sampling and analysis procedures are precleaned according to the method requirements. Standard laboratory practices for laboratory cleanliness, personnel training, and other general requirements will be used, and the results of these QC procedures will be included in the final report.

10.1 METHOD BLANKS

Method blanks contain all the reagents used in the preparation and analysis of samples and are processed through the entire analytical scheme to assess any spurious contamination that might arise from reagents, glassware, and other sources. The QC criteria for method blanks are shown in Annex A by individual method.

10.2 LABORATORY CONTROL SAMPLES

The LCS are samples generated from analyte spikes into a neutral matrix prepared independently from the calibration concentrates. The LCS is used to establish that an instrument or procedure is in control. An LCS is normally carried through the entire sample preparation and analysis procedure. The QC criteria for the LCS are listed in Annex A by analysis method.

10.3 DUPLICATE ANALYSES

Duplicate sample analysis will be used to evaluate the variance in a particular applied analytical method. Field duplicate samples will be collected for the mustard agent, Brine, and Decon samples during one performance run. Samples analyzed by CVAAS will be analyzed in duplicate as specified in the method. Duplicate analyses will be performed on the halogen samples analyzed by IC. One of the metals emission samples will also be analyzed in duplicate as a measure of the precision of the analysis method. The agent purity analyses will be determined in duplicate as well.

10.4 MATRIX SPIKE SAMPLES

Matrix spikes are samples spiked with the analyte of interest and then analyzed to determine a %R. It is anticipated that these analyses would assess the behavior of actual analyses in individual program samples during the entire preparative and analysis scheme. Matrix spike analysis will be conducted to evaluate accuracy and general matrix recovery. An MS/MSD will be prepared from the process water, Brine, and Decon samples. The QC criteria for %R and RPD are shown in Annex A for each method.

10.5 SURROGATE SPIKES

Surrogate spikes will be used for GC/MS analysis methods as an indicator of the general accuracy of sample preparation and analysis. The QC criteria for surrogate spike recoveries are listed in Annex A by analysis method. The following surrogate compounds will be used for VOC analyses: toluene-d₈, bromofluorobenzene; and 1,2-dichloroethane-d₄. The following surrogate compounds will be used for analysis of SVOCs: nitrobenzene-d₅; fluorobiphenyl; terphenyl-d₁₄; phenol-d₆; 2-fluorophenol; and 2,4,6-tribromophenol. Surrogate spikes will also be used for Method 8290 for PCDD/PCDF analyses.

10.6 ANALYTICAL INSTRUMENT CALIBRATION

The analytical instrumentation used in the laboratory for analysis of LIC Mustard ATB samples will undergo several performance checks. An initial calibration curve will be analyzed before performing any samples analyses to compare linearity of response to concentration of known amounts of the analytes of interest. The initial calibration for some methods will use a calculated Correlation Coefficient (CC) to demonstrate acceptability of the calibration. On a daily basis, a continuing calibration check will be analyzed before any samples are run for that day. If acceptance criteria, as specified in the appropriate analytical methods for initial or continuing calibrations, are not met, sample analysis will not proceed until the analytical problem has been rectified and the criteria have been met. Linearity checks will be used to verify that response has not shifted significantly from the most recent calibration. Some methods will use an Initial Calibration Verification (ICV) to demonstrate that the calibration was accurate, and Continuing Calibration Verification (CCV) will be used to ensure that the calibration is still representative. A summary of the calibration procedures and frequency for the laboratory instruments to be used for this project is provided in Table A-10-1. The instrument initial calibration procedures and acceptance criteria will be those established in the analytical method and listed in Annex A. Internal standards will be analyzed to evaluate instrument and method performance. The QC criteria for the internal standards are listed in Annex A by analysis method.

TABLE A-10-1. CALIBRATION PROCEDURES FOR ANALYTICAL METHODS

Method	Analytical Equipment	Calibration Curve	Calibration Checks	Target Criteria
6010B	ICP	Calibration blank and one standard	CCV every 10 samples and at the end of the run sequence	CCV \pm 10% of known value
7470A/7471A	CVAAS	Calibration blank and 5 standards to give CC>0.995	CCV every 10 samples and at the end of the run sequence	CCV \pm 10% of known value
6020A	ICP/MS	Calibration blank and one standard	CCV every 10 samples and at the end of the run sequence	CCV \pm 10% of known value
5041A/8260B	GC/MS	Five-point calibration*	CCC** every 12-hour tune period	Drift \leq 20%
8270C	GC/MS	Five-point calibration*	Verified every 12-hour tune period	Variability of average RRF of 30% RSD
8290	HRGC/HRMS	Five-point calibration	Verified every 12-hour tune period	Variability of average RRF of 30% RSD
DAAMS	GC	Three-point calibration	Verified every 12 operating hours or 20 samples	See Annex A
Method 5	Analytical Balance	NIST traceable weights	Beginning and end of day	Self-taring
9057	Ion Chromatograph	Four-point calibration giving a CC >0.995	CCV every 10 samples and at the end of the sequence	CCV \pm 10% of known value

Notes:

CCC = Calibration Check Compound

RRF = Relative Response Factor

NIST = National Institute for Standards and Technology

*Selected PIC compounds will be calibrated with a one-point curve.

11.0 DATA REPORTING, DATA REVIEW, AND DATA REDUCTION

Reporting the data generated during an ATB is an important part of the overall project. This section describes and discusses the components of reporting, reviewing, and reducing the collected ATB data.

11.1 DATA REPORTING

The data reporting process will discuss the analytical data packages, review of the data generated for this ATB, and the final LIC Mustard ATB Report.

11.1.1 Analytical Data Packages

Data reported from commercial laboratories will be required to be similar to the format used by the EPA Contract Laboratory Program (CLP). This format will include a case narrative section, Analytical Data Summary Sheets, QC Sample Results, the COC forms, and raw data organized by analytical method. Complete data packages are included so that an independent verification of the final analytical results can be conducted. These data packages are stand-alone deliverables that include the instrument raw data, parameter-specific QC documentation, calibration and calibration check performance, and instrumentation performance information.

The case narrative will:

- Describe the data package and identify project-specific information.
- Discuss any pertinent information concerning data quality and any difficulties or analytical anomalies encountered in the analyses.
- Provide a cross-reference listing of the field sample and laboratory sample identities.
- Discuss information on achieving DQOs or project-specific objectives.

The Analytical Data Summary Sheets will contain a summary of the analytical results and the key QC data. A separate sheet will be provided with the results for each sample. These data will include the results, recovery of any surrogate materials, date sampled, and analysis date, which will allow confirmation of meeting the QC and holding time requirements. Summary sheets for the analysis of the QC samples will follow the sample results sheets.

Copies of the COC forms are also a part of the data package. These copies are submitted with the samples and copies of any internal COC forms used to track the samples through the different analyses in the laboratory.

Raw data will be included in the Analytical Data Packages. This raw data will include chromatograms for those methods generating them, blank data, sample preparation sheets, copies of sequence files, and calibration data. The raw data will be organized by analysis method, and enough data will be supplied to allow recreation of the sample analysis event.

11.1.2 Analytical Data Format

The data that will be reported as "not detected" will use the PQL for the lower reporting limit. Analytes detected with a concentration between the MDL and the PQL will be qualified as an estimate and reported. The PQL is the same as the reporting limit used by some laboratories. The PQL will be defined as the quantitation level that corresponds to the lowest level at which the entire analytical system gives reliable signals and an acceptable calibration point or low-level matrix spike. Each compound or element is assigned a PQL that is contingent upon the behavior of the compound or element during analysis. Changes to extraction protocol, amount of sample prepared, or dilution applied to the sample can raise or lower the PQL.

The analytical results for PCDDs/PCDFs are quantitated differently. They are quantitated using an isotope dilution method. Each sample is spiked with an isotopically-labeled surrogate for each target compound. On a sample-by-sample basis, the recovery of each surrogate is determined; then, the analytical result is normalized to the recovery of the corresponding surrogate compound. In this manner, the PQL for each sample and each compound can vary as the surrogate recovery varies. This isotope dilution method is considered to be the most accurate quantitation method available for these analyses.

Sample analysis results will be reported by the laboratory in matrix-specific units. Results will be reported for all samples and parameters required for this ATB, as listed in Table A-9-1. The laboratory will assign qualifiers to the results, when necessary, based on guidelines found in the analytical method, CLP, or in this QAPP. Qualifiers appearing on the analytical summary sheets are defined on that specific sheet. Data presented in tables in the LIC Mustard ATB Report will note any data qualifiers.

11.1.3 LIC Mustard ATB Report

A LIC Mustard ATB Report will be prepared and submitted to the DAQ and DSHW. EG&G will complete the ATB report as outlined in Appendix F to the ATB plan. The report will compare the ATB results to the RCRA Permit, Title V permit, and MACT Limits.

The LIC Mustard ATB Report will also contain:

- Daily run summaries.
- A summary of incinerator operating parameter data and associated limits.
- A summary of sampling and analytical methods used and any deviations from referenced methods.
- Analysis results, protocols, and quantitative gas analyses.
- CEMS data emission averages and calculations.
- A compilation and evaluation of analytical calibration data and QA/QC data, and identification of problems encountered and the solutions implemented.
- Copies of log books, laboratory notebooks, calibration data, chromatograms, and other raw data.
- Audit cylinder results calculated in parts per billion (ppb)
- Examples of all calculations, sampling train data, concentrations, and emission rates for all gases and particulate samples collected.

A QA/QC Report will be submitted to the EG&G CAR and included in the LIC Mustard ATB Report as an appendix. Additionally, each formal data deliverable will contain a summary of QA/QC activities. This summary will include:

- Estimates of precision, accuracy, and completeness of reported data.
- Reports of performance and system audits.
- Any quality problems found.
- Any corrective actions taken.

11.2 DATA REVIEW

The STC will review the field sampling data to determine the representativeness of the samples; maintenance and cleanliness of sampling equipment; and the adherence to the approved, written sample collection procedure. All field data will be recorded on prepared forms, and the data sheets will be reviewed at the end of each run by the STC and the Field QC Officer to ensure that each sheet is properly completed. The gas sampling data will be reduced on-site to verify isokinetic sampling rates. Furthermore, the sampling subcontractor's software for determining

sample volumes and isokinetic sampling rates will be checked for accuracy against an independent program, and any differences resolved before inclusion in the final report.

The analyst generating the data will review the laboratory data; then, the analyst's supervisor will review the data. The laboratory QC personnel will further review the data per the laboratory procedure before the project report is prepared by the Subcontractor Laboratory Project Manager. When the analytical data are submitted to the sampling subcontractor, the data will again be reviewed before it is used to prepare the LIC Mustard ATB Report. This review process will confirm that the data are usable for an assessment of incinerator performance.

11.2.1 Data Validation

Data validation is the process of accepting or rejecting data on the basis of established criteria. Analytical and sampling data will be validated by the ATB subcontractor QC personnel using criteria outlined in this QAPP. The subcontractor QC personnel will use validation methods and criteria appropriate to the type of data, even data judged to be "outlying" or spurious value. The persons validating the data will have sufficient knowledge (i.e., at least one year of experience in data validation) of the sampling and analytical methods to identify questionable values and deviations from criteria specified in the methods and the QAPP.

The results from the field and laboratory method blanks, replicate samples, and internal QC samples will be used to further validate analytical results. Analytical results on the field blanks and replicate samples also are valuable for validation of sample collection. The QA/QC personnel will review all laboratory and sampling raw data to verify: calculated results presented, consistency, duplicate sample analysis, spike recoveries, tests for outliers, and transmittal errors.

The criteria that will be used to evaluate the field sampling data include:

- Use of approved test procedures.
- Proper operation of the process being tested.
- Use of properly operating and calibrated equipment.
- Use of proper forms for recording data, including identification numbers for each nozzle, probe, and dry gas meter.
- Leak checks conducted before tests, during port changes, and after tests.
- Use of reagents that have conformed to QC-specified criteria.
- Maintenance of proper traceability.

The criteria used to evaluate analytical data include:

- Use of approved analytical procedures.
- Use of properly operating and calibrated instrumentation.
- Precision and accuracy should be comparable to that achieved in previous analytical programs and consistent with the DQOs listed in Annex A.

See Section 10.0 for the anticipated minimum number of QC samples. The %R of each matrix will be calculated as shown in Section 13.0. Inorganic data will be evaluated using the general methods outlined in the EPA CLP guidelines for inorganic data (13) using the criteria from Annex A. The organic data will be evaluated using the general methods outline in the EPA CLP guidelines for low level organic data (14). The PCDD/PCDF data will be evaluated using the general methods outline in the EPA guidelines for dioxin data (15). These evaluations will be included in the QA report which will be an appendix to the final report.

11.2.2 Identification and Treatment of Outliers

Any point that deviates from others in its set of measurements will be investigated; however, the suspected outlier will be recorded and retained in the data while it is under investigation. One or both of the following tests will be used to identify outliers:

- Dixon's test for extreme observations, which is a computed procedure for determining whether a single, very large or very small value is consistent with the data set.
- The one-tailed t-test for difference.

If more than one outlier is suspected in the same data set, other statistical sources will be consulted, and the most appropriate test of the hypothesis will be used and documented.

Those persons involved in the analysis and data reduction will be consulted if a data outlier is suspected, as they may be able to add some insight to the evaluation of the suspect data. This evaluation may provide an experimental basis for the outlier to determine its affect on the conclusions. Two data sets may be reported – one including, and one excluding, the outlier.

11.3 DATA REDUCTION

Specific QC measures will be used to ensure the generation of reliable data from sampling and analysis activities. Proper collection and organization of accurate information, followed by clear and concise reporting of the data, is a primary goal in all projects.

11.3.1 Field Data Reduction

Annex B contains the standardized data sheets that will be used to record gas sampling data. Raw sampling data will be reduced on a daily basis and will be reviewed in the field by the STC and the sampling team leader. Isokinetic sampling rates and sample volumes will be reported daily. Any errors or discrepancies will be noted in a field notebook. The sampling team leader has the authority to institute corrective actions in the field, and the STC will also be consulted for resolution if the situation warrants. At a minimum, the Field QC Officer and the EG&G CAR will be apprised of all deviations from the standard protocol.

11.3.2 Laboratory Analysis Data Reduction

Analytical results will be reduced to concentration units specified by the analytical procedure and using the equations given in the analytical procedures. Results will be reported on an as received basis. If the units are not specified, then units for data will be used as follows:

- Liquid samples will be reported in units of milligram per liter (mg/L).
- Solid samples will be reported in milligram per kilogram (mg/kg).
- Neat Agent sample results will be reported in weight percent (Wt%) and mg/kg.
- Gas samples will be reported on a mass per dry standard cubic unit of measure except for the halogen emissions and results from the CEMS, which are reported in parts per million (ppm).
- Oxygen and carbon dioxide data will be reported in volume percent.
- Audit cylinder analysis results will be reported in parts per billion (ppb).
- Exhaust gas concentrations of mustard agent will be reported in micrograms per cubic meter ($\mu\text{g}/\text{m}^3$).

11.3.3 Blank Corrected Data

Results from the metals emissions train will be blank corrected as instructed in Method 29 (6). A separate blank correction will be made for the front half and the back half. The raw data will also be reported. The other data developed for this ATB will not be blank corrected.

11.4 EXHAUST GAS SAMPLE TRAIN TOTAL CALCULATIONS

The calculation of the train total of an analyte is the sum of two or more fractions of train components. Analytes not detected in the analysis will be reported as < PQL. Analytes with concentrations between the MDL and the PQL will be qualified as estimated and reported. The summation for the total will use the PQL value for those analytes not detected and the reported values for those analytes detected including values between the MDL and PQL. Totals including PQL and qualified data will have a “<” flag added to the reported total. When the analyte is not detected in any of the fractions, the PQL value for each fraction will be summed for the total, and the results flagged with an “ND” to indicate the analyte was not detected.

Calculations will be carried out to at least one decimal place beyond that of the acquired data and should be rounded, after final calculations, to two significant figures for each analyte for a train total. Rounding of numbers should conform to procedures found in ASTM SI-10 (16).

11.4.1 Calculation of Mustard Agent Emissions and DRE

An important ATB parameter is the DRE for the agent material. If no agent is detected above the PQL for the DAAMS tubes, then the PQL will be used as the concentration of mustard agent in the exhaust gas. The PQL value will be used in the DRE calculation, and the DRE will be reported as greater than (>) the value calculated. The DRE is a percentage and will be calculated for agent using the following formula:

$$DRE = \frac{(W_{in} - W_{out}) \times 100}{W_{in}}$$

Where:

W_{in} = Mass Feed Rate of Agent (Gross Feed Rate x Purity)

W_{out} = Mass Emission Rate of Agent in Exhaust Gas

For the DRE calculation, W_{in} will be determined using the agent feed rate data taken from the Agent Feed Totalizer in PDARS. The calculated feed rate will be corrected for agent purity as determined by the TOCDF CAL. The W_{out} will be calculated using the duct volumetric flow rate determined from the averages of the 4-hour trains (Method 0010, Method 0023A) and the agent exhaust gas concentration determined in the DAAMS tubes by the CAL. For DRE calculation purposes, the PQL of 1.07 ng/sample will be used.

Mustard agent will be sampled and analyzed using DAAMS tubes. The DAAMS tubes will be collected for one hour, and then a new set of DAAMS tubes will collect the sample for the next hour. This process will be repeated until the run is completed, which will result in five or six

DAAMS tube sets being collected for each run. The agent concentration and emission rate are calculated by preparing a sum of the agent detected in each tube or taking the LOQ value for each tube. The gas volume sampled will also be prepared as a summation of the gas through each tube used for the agent summation. Table A-11-1 shows the data used for an example calculation for mustard agent concentrations and emission rates.

TABLE A-11-1. MUSTARD AGENT EMISSIONS CALCULATION DATA

Time Sample Collection Ended	Mustard Collected (ng)	Total Sample Volume (L)	Exhaust Gas Flow Rate (acfm) *	Exhaust Gas (average %)
09:00	< 1.07	54.3		
10:00	< 1.07	57.3		
11:00	< 1.07	56.1		
12:00	< 1.07	60.0		
13:00	< 1.07	57.0		
14:00	< 1.07	62.1		
Totals	< 6.42	346.8	13,859	5.15

* Estimated value from LIC VX ATB Results.

The Total Exhaust Gas (TEG) sampled is calculated from the Average Percent Exhaust Gas and the Total Sample Volume using the equation:

$$\text{TEG} = (346.8 \text{ liters}) \times (0.0515) = 17.86 \text{ liters}$$

The average mustard agent concentration is calculated from the Total Agent Collected and the TEG using the equation:

$$\text{Mustard agent Conc., } \mu\text{g/m}^3 = [(<6.42 \text{ ng}) / (17.86 \text{ liters})] \times (1 \mu\text{g}/1000 \text{ ng}) \times (1000 \text{ liters}/\text{m}^3)$$

$$\text{Mustard agent Conc., } \mu\text{g/m}^3 = < 0.3595 \mu\text{g/m}^3$$

The mustard agent emission rate (ER) is calculated from the mustard agent concentration and the exhaust gas flow rate using the equation:

$$\begin{aligned} \text{ER, g/sec} = (< 0.3595 \mu\text{g/m}^3) \times (13,859 \text{ ft}^3 / \text{min}) \times (1 \text{ min} / 60 \text{ sec}) \times (1 \text{ m}^3 / 35.3147 \text{ ft}^3) \\ \times (1 \text{ g} / 1,000,000 \mu\text{g}) \end{aligned}$$

$$\text{ER, g/sec} = < 2.35 \times 10^{-6} \text{ g/sec}$$

$$\begin{aligned} \text{ER, lb/hr} &= (< 2.35 \times 10^{-6} \text{ g/sec}) \times (3600 \text{ sec/hr}) \times (\text{lb} / 453.59 \text{ g}) \\ \text{ER, lb/hr} &= < 1.87 \times 10^{-5} \text{ lb/hr} \end{aligned}$$

Determine DRE:

An example of the DRE calculation methodology is as follows:

$$\frac{[(1275 \text{ lb/hr} \times 89.1\% \text{ Purity}) - < 1.87 \times 10^{-5} \text{ lb/hr}]}{1275 \text{ lb/hr} \times 89.1\% \text{ Purity}} \times 100\% = > 99.9999984\%$$

11.4.2 Calculation of Chlorobenzene Emissions and DRE

Chlorobenzene is a HAP that was chosen to be the surrogate for organic compounds fed to the SCC because it is a Class 1 compound in the EPA's thermal stability ranking system. Chlorobenzene is also a VOCs identified in the emissions of incinerators. The calculations of the chlorobenzene emissions are shown here as an example calculation for VOC emissions. The chlorobenzene emissions are calculated from the example data shown in Table A-11-2.

TABLE A-11-2. CHLOROBENZENE EMISSIONS CALCULATION DATA

Sample Identification	Tenax® Tubes, (ng)	Anasorb®-747 Tube (ng)	Sample Volume [dry standard Liters (dsL)]
Sample 1a	24	<10	19.7
Sample 1b	32	<10	19.9
Sample 1c	28	<10	19.8
Sample 1d	30	<10	19.7
Condensate (ng total)	< 80		
Train Total (ng)	< 234		79.1

The chlorobenzene concentration is calculated from the Train Total of chlorobenzene collected and the Sample Volume using the equation:

$$\begin{aligned}\text{Conc., } \mu\text{g/dscm} &= (< 234 \text{ ng/79.1 dsL}) \times (1 \mu\text{g}/1000 \text{ ng}) \times (1000 \text{ dsL/dscm}) \\ &= < 2.96 \mu\text{g/dscm}\end{aligned}$$

The chlorobenzene ER is calculated from the chlorobenzene concentration and the exhaust gas flow rate using the equation:

$$\text{ER} = \text{Conc., } \mu\text{g/dscm} \times \text{Exhaust Gas Flow Rate}$$

$$\begin{aligned}\text{ER, g/sec} &= (< 2.96 \mu\text{g/dscm} \times 4067 \text{ dscf/min}) \times (1 \text{ min}/60 \text{ sec}) \times (1 \text{ dscm}/35.3147 \text{ dscf}) \\ &\quad \times (1 \text{ g}/10^6 \mu\text{g}) \\ &= < 5.6 \times 10^{-6} \text{ g/sec}\end{aligned}$$

$$\text{ER, lb/hr} = (< 5.6 \times 10^{-6} \text{ g/sec}) \times (3600 \text{ sec/hr}) \times (\text{lb}/453.59 \text{ g}) = < 4.44 \times 10^{-5} \text{ lb/hr}$$

Where: Exhaust Gas Flow Rate = 4,067 dscf/min

Determine DRE:

$$\frac{(10 \text{ lb/hr} - < 4.44 \times 10^{-5} \text{ lb/hr})}{10 \text{ lb/hr}} \times 100\% = >99.99956\%$$

12.0 ROUTINE MAINTENANCE PROCEDURES AND SCHEDULES

The sampling subcontractor will follow an orderly program of positive action to prevent the failure of equipment or instruments during use. This preventative maintenance and careful calibration helps to ensure accurate measurements from field and laboratory instruments.

All equipment that is scheduled for field use will be cleaned and checked prior to calibration. Once the equipment has been calibrated, sample trains are assembled and leak checked to reduce problems in the field. An adequate supply of spare parts will be available in the field to minimize any downtime caused by equipment failure.

The TOCDF CEMS are operated and maintained in accordance with Attachment 20 to the TOCDF RCRA Permit (5). Maintenance is performed on a regularly scheduled basis prior to use in the field and includes, but is not limited to, purging of sample lines, checking pump oil and belts, cleaning rotometers or other sample flow monitoring devices, and checking sample capillaries and mirrors. Routine maintenance procedures are critical for ensuring the continuous, trouble-free operation of the CEMS in adverse environments.

The sampling subcontractor will maintain their CEMS in accordance with the specific methods and manufacturer specifications. Sample lines will be inspected daily to ensure no leaks or other problems occur. The subcontractor laboratories will maintain their instrumentation in accordance with the instrument manufacturer specifications and appropriate methods. In addition, the laboratories will maintain a stock of replacement parts to minimize downtime resulting from foreseeable breakage or typical consumption.

13.0 ASSESSMENT PROCEDURES FOR ACCURACY, PRECISION, AND COMPLETENESS

The QA/QC criteria for the analyses of samples for this project are presented in Annex A. Annex A contains criteria for method calibrations, data accuracy, and precision of data. Each method has a set of criteria to meet, and the methods of calculating the evaluation criteria are discussed in this section.

13.1 PRECISION

Precision is defined as the degree of mutual agreement among individual measurements made under prescribed conditions. Precision will use two different measurements depending on the number of data points being considered. Two data points will have the RPD calculated; three or more data points will use the RSD as a measure of the precision. Criteria for precision for each method have been included in Annex A.

Precision will be calculated for laboratory duplicate analysis using the following two equations:

$$1) \text{ RPD} = [(X_1 - X_2) / ((X_1 + X_2) / 2)] \times 100$$

Where: RPD = Relative Percent Difference
X₁ = Highest Analytical Result
X₂ = Lowest Analytical Result

$$2) \text{ RSD} = (\text{standard deviation} / \text{average value}) \times 100$$

Calculation of the precision for each analysis will be based on different criteria taken from the QA/QC Handbook (4) and the analytical methods. The precision for the halogen samples will be determined by the RPD calculated from the analysis of the MS/MSD. The MS/MSD will be used because the field samples have a history of very low concentrations. The precision of the SMVOC samples will be based on the RSD calculated from the analysis of the LCS, and the precision of the SVOCs will be based on the RPD from the analysis of the LCS. The results of the LCS analyses will be used because of the historically low concentrations found in field samples. Precision for the metals emission samples will be based on the RPD of the LCS and duplicate analyses of one emission sample. Precision data for metals in the process samples will be based on analyses of MS/MSD and duplicate samples.

13.2 ACCURACY

Accuracy is the degree of agreement between a measurement and an accepted reference or true value. The accuracy of the LIC Mustard ATB data will be determined from analysis of samples spiked with a known concentration. The number of spiked samples and the spiking levels will be designated by the respective methods. Accuracy DQOs for each method are in Annex A.

The formula used to assess the accuracy of the LCS is:

$$\%R = (Q_{LCS} / Q_{KC}) \times 100$$

Where: %R = Percent Recovery
Q_{LCS} = Quantity of Analyte Found in the LCS
Q_{KC} = Known Concentration of the LCS

The formula used to assess the accuracy of the MS/MSD samples is:

$$\%R = [(Q_{ss} - Q_{us}) / Q_s] \times 100$$

Where: %R = Percent Recovery
Q_{ss} = Quantity of Analyte Found in the Spike Sample
Q_{us} = Quantity of Analyte Found in the Unspiked Sample
Q_s = Quantity of Added Spike

Calculation of the accuracy for each analysis will be based on different criteria taken from the QA/QC Handbook (4) and the analytical methods. Determination of accuracy for samples will be determined by the:

- %R calculated from the analysis of the MS/MSD for the halogen samples.
- %R calculated from the analysis of the LCS for the SMVOC samples.
- %R from the analysis of the LCS for the SVOC samples.
- Analysis of the LCS for the accuracy of the metals emission samples.
- Analysis of the LCS for the PCDD/PCDF samples.

13.3 COMPLETENESS

Completeness is defined as the amount of valid data for an ATB compared to the amount that was expected to be obtained under optimal conditions. The completeness objective here is to have 100 percent of the data valid for three performance runs for each ATB (i.e., acceptable results must be obtained for three performance runs). The completeness objective for the entire monitoring project is to obtain a certain amount of data needed to complete the statistical design [see QA/QC Handbook (4)].

Completeness will be reported as the percentage of all measurements judged to be valid, and every attempt will be made to ensure that the data to be generated is valid. If data appear questionable based on circumstances observed during the field sampling, additional runs will be completed as soon as the system can be reset to ensure three successful performance runs are completed. Furthermore, in reality, some samples may be lost in laboratory accidents, and some results may be qualified based on laboratory QC procedures.

The following formula will be used to calculate a percent completeness:

$$C = (V/T) \times 100 \%$$

Where: C = Percent Completeness

V = Number of Measurements Judged Valid

T = Total Number of Planned Measurements

14.0 AUDIT PROCEDURES, CORRECTIVE ACTION, AND QUALITY ASSURANCE REPORTING

The LIC Mustard ATB QA program will comply with EPA and state requirements for audits, which include performance and system audits as independent checks on the quality of data obtained from sampling, analysis, and data gathering activities. The procedures and techniques in place will ensure that the audit is representative of the measurement processes during normal operations. Either type of these two audits may show the need for corrective action.

14.1 PERFORMANCE AUDITS

A performance audit checks the performance or accuracy of the measurements being made. The sampling and analysis segments of the project are checked in a performance audit. Sampling performance audits will be accomplished through observation of the sampling operations by the regulatory agency representative and the Field QC Officer. For this purpose, an audit cylinder or spiked audit samples may be supplied by the DSHW during the LIC Mustard ATB. In the event an audit cylinder is supplied, it will be sampled and analyzed in the same manner as the field samples. If a spiked sample is supplied, it will be extracted and analyzed according to the same methods used for the field samples.

14.2 SYSTEM AUDITS

A system audit involves observations by a subcontractor or a regulatory agency to ascertain that the work is being performed in accordance with the methods specified in this QAPP.

14.2.1 Field Audit

The Field QC Officer will observe all activities to ensure that the QAPP is being followed and that sample COCs are accurate before sample shipment. The Field QC Officer will report any discrepancies to the STC, complete an ATB QA checklist, maintain a log of discrepancies for the STC and the QA Director, and attend performance run meetings.

Representatives from the DSHW are expected to be on-site to observe all sampling activities. The point of contact for federal and state environmental regulatory agencies staff during the LIC Mustard ATB will be the Test Director or his designee.

During each performance run, the sampling subcontractor performs a system audit, which consists of an inspection and review of the total sampling system, including:

- Setting up a pretest leak check of the sampling trains.
- Isokinetic sampling check (if required).
- Final leak checks of the sampling train.
- Sample recovery.
- Sample analyses, if done on-site.

Results of the leak checks are noted on the field data sheets while the remaining item checks are documented on the audit checklist. When necessary, audit samples are analyzed along with the test samples.

14.2.2 Laboratory Audit

The Test Director will direct that an audit of each laboratory be conducted to ascertain that work is performed in accordance with the methods specified in the QAPP. Auditors will be selected from the EG&G Environmental Department, TOCDF QC Inspectors, or the sampling subcontractor's QC Department.

14.3 CORRECTIVE ACTION

The need for corrective action will occur when a circumstance arises that adversely affects the quality of the data output. In most instances, the personnel conducting the field work and the laboratory analysis will be in the best position to recognize problems that will affect data quality. Awareness on their part can detect minor instrument changes, drifts, or malfunctions that can then be corrected, thus preventing a major breakdown of the system. They will be in the best position to decide upon the proper corrective action and initiate it immediately, thus minimizing data loss. Therefore, the field sampling and laboratory analysis personnel will have the prime responsibility for recognizing the need for a nonconformance report. The personnel identifying or originating a nonconformance report will document each nonconformance. For this purpose, a variance log, a testing procedure record, a notice of equipment calibration failure, results of laboratory analysis QC tests, an audit report, an internal memorandum, or a letter will be used, as appropriate.

15.0 REFERENCES

- (1) ***Test Methods for Evaluating Solid Waste, Physical/Chemical Methods***, 3rd Edition including Update III, USEPA, SW-846, December 1996.
- (2) ***Hazardous Waste Combustion Unit Permitting Manual, Component 2***, "How to Review A Quality Assurance Project Plan," U.S. EPA Region 6, Center for Combustion Science and Engineering, January 1998.
- (3) ***EPA Guidance for Quality Assurance Project Plans***, EPA QA/G-5, December 2002.
- (4) ***Handbook: Quality Assurance/Quality Control (QA/QC) Procedures for Hazardous Waste Incineration***, EPA/625/6-89/023, January 1990.
- (5) **Attachment 20 to the TOCDF RCRA Permit, CEMS Monitoring Plan**, EG&G Defense Materials, Inc., TOCDF, **CDRL-06**.
- (6) Title 40, ***Code of Federal Regulations***, Part 60, Appendix A, "Test Methods."
- (7) ***Guidance for Total Organics***, Final Report, EPA/600/R-96-036, March 1996.
- (8) **Attachment 22 to the TOCDF RCRA Permit, AGENT MONITORING PLAN**, EG&G Defense Materials, Inc., TOCDF, **CDRL**.
- (9) American Society for Testing and Materials (ASTM) Method D3370, "Standard Practices for Sampling Water from Closed Conduits."
- (10) American Society for Testing and Materials (ASTM) Method D5633, "Standard Practice for Sampling with a Scoop."
- (11) **Attachment 6 to the TOCDF RCRA Permit, INSTRUMENT CALIBRATION PLAN**, EG&G Defense Materials, Inc., TOCDF.
- (12) ***Quality Assurance Handbook for Air Pollution Measurement Systems; Volume III - Stationary Source Specific Methods***, EPA-600/4-77-027b.
- (13) ***USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Review***, EPA-540-R-04-004, October 2004.

- (14) ***USEPA Contract Laboratory Program National Functional Guidelines for Low Concentration Organic Data Review***, EPA-540-R-00-006, June 2001.
- (15) ***USEPA Analytical Operations/Data Quality Center National Functional Guidelines for Chlorinated Dioxin/Furan Data Review***, EPA-540-R-02-003, August 2002.
- (16) American Society for Testing and Materials, ASTM SI-10, "International System of Units."

MUSTARD AGENT TRIAL BURN PLAN

FOR THE LIQUID INCINERATORS

APPENDIX A

ANNEX A

QA/QC OBJECTIVES FOR ANALYTICAL METHODS

REVISION 1

April 6, 2006

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1.0 INTRODUCTION

QA/QC OBJECTIVES FOR ANALYTICAL METHODS

These Quality Assurance/Quality Control (QA/QC) objectives are prepared based on the input from the laboratories performing the analyses for the Liquid Incinerator (LIC) Mustard Agent Trial Burn (ATB). The objectives were developed from the guidance provided in the EPA reference methods (1, 2, 3), EPA Guidance for Quality Assurance Project Plans (4), each laboratory QA program, and guidance in the EPA QA/QC Handbook (5). The DSHW will be notified of any changes to these tables when they occur.

2.0 VOLATILE ORGANIC COMPOUNDS IN EXHAUST GAS

2.1 Summary QA/QC Criteria for SMVOC/Condensate (5041A)

QUALITY PARAMETER	METHOD/FREQUENCY	CRITERIA	CORRECTIVE ACTION
Field/Trip Blanks	1 per run	<Lowest standard	Report and narrate.
Lab Blanks	1 per analytical batch	<Lowest standard	Correct problem, reanalyze.
Tuning Criteria	Prior to calibration and every 12-hour period.	Method 5041A tuning criteria	Correct problem and repeat tune
Initial Calibration	Minimum of five levels	Relative Standard Deviation (RSD) of Relative Response Factor (RRF) $\leq 30\%$ *; RSD $\leq 15\%$ **	Correct problem, reanalyze.
	System Performance Check Compounds (SPCC) RRF	>0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; >0.10 for Bromoform, chloromethane, and 1,1-dichloroethane	Correct problem, reanalyze.
	Continuing Calibration Compounds (CCC)	RRF $\leq 30\%$ RSD* RRF $\leq 15\%$ RSD**	Correct problem, reanalyze.
Continuing Calibration,	SPCC RRF/12 hours	Same as initial	Correct problem, reanalyze.
	CCC/12 hours	$\pm 25\%$ Difference (%D)	Correct problem, reanalyze.
Consistency in Chromatography	Internal standard RRT	± 30 Seconds	Correct problem, narrate.
	Internal standards	60% to 140%	Correct problem, narrate.
Laboratory Control Samples (LCSs)	Accuracy	70%-130% Recovery (%R)* 50% - 150 %R**	Correct problem, reanalyze.
	Precision	$\leq 25\%$ RPD* $\leq 50\%$ RPD**	Correct problem, reanalyze.
Continuing Accuracy Check, Surrogates	Dibromofluoromethane Toluene-d ₈ 4-Bromofluorobenzene 1,2-Dichloroethane-d ₄	SMVOC Tube %R limits are: 50 to 150% Condensate %R limits are: 70-130%	Correct problem, narrate.
Audit Samples	As supplied	50 - 150 %	
Condensate	MS/MSD	See Table 2.2	Reanalyze.
Holding Time		14 Days	Contact client.

* Criteria for 1,1,2,2-tetrachloroethane, 1,1-dichloroethene, 1,2,3-trichloropropane, 1,2-dichloropropane, 1,3-butadiene, 2-hexanone, 4-methyl-2-pentanone, bromoform, chloroform, ethylbenzene, toluene, and vinyl chloride.

** Criteria for remaining Compounds

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2.2 Condensate Matrix Spike and Matrix Spike Duplicate Evaluation Criteria

COMPOUND	RECOVERY	RELATIVE PERCENT DIFFERENCE
1,1-Dichloroethene	50 - 150%	35%
Trichloroethene	50 - 150%	35%
Chlorobenzene	50 - 150%	35%
Toluene	50 - 150%	35%
Benzene	50 - 150%	35%

2.3 Practical Quantitation Limits for SMVOC Tubes/Condensate

COMPOUND	TUBE PQL (ng)	CONDENSATE PQL * (ng)	PRIMARY ION M/E AMU
Acetone	50	400	58
Benzene	10	80	78
Bromobenzene	10	80	77
Bromochloromethane	10	80	128
Bromodichloromethane	10	80	83
Bromoform	10	80	173
Bromomethane	10	80	94
2-Butanone	50	400	91
Carbon Disulfide	10	80	76
Carbon Tetrachloride	10	80	117
Chlorobenzene	10	80	112
Chloroethane	10	80	64
Chloroform	10	80	83
Chloromethane	10	80	50
2-Chloropropane	10	80	91
2-Chlorotoluene	10	80	126
4-Chlorotoluene	10	80	91
Cumene (<i>iso</i> -propylbenzene)	10	80	105
Dibromochloromethane	10	80	129
1,2-Dibromoethane	10	80	107
Dibromomethane	10	80	93
<i>cis</i> -1,4-Dichloro-2-butene	10	80	53
<i>trans</i> -1,4-Dichloro-2-butene	10	80	53
Dichlorodifluoromethane	10	80	85
1,1-Dichloroethane	10	80	63
1,2-Dichloroethane	10	80	62
1,1-Dichloroethene	10	80	96
<i>cis</i> -1,2-Dichloroethene	10	80	96
<i>trans</i> -1,2-Dichloroethene	10	80	96
1,2-Dichloropropane	10	80	63

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2.3 Practical Quantitation Limits for SMVOC Tubes/Condensate (continued)

COMPOUND	TUBE PQL (ng)	CONDENSATE PQL * (ng)	PRIMARY ION M/E AMU
1,3-Dichloropropane	10	80	76
2,2-Dichloropropane	10	80	77
1,1-Dichloropropene	10	80	75
<i>cis</i> -1,3-Dichloropropene	10	80	75
<i>trans</i> -1,3-Dichloropropene	10	80	75
Ethylbenzene	10	80	106
n-Hexane	10	80	57
2-Hexanone	50	400	58
Iodomethane (Methyl Iodide)	10	80	142
Methylene chloride	10	80	84
4-Methyl-2-Pentanone	50	400	43
Propylbenzene	10	80	120
Styrene	10	80	104
1,1,1,2-Tetrachloroethane	10	80	131
1,1,2,2-Tetrachloroethane	10	80	83
Tetrachloroethene	10	80	164
Toluene	10	80	92
1,1,1-Trichloroethane	10	80	97
1,1,2-Trichloroethane	10	80	97
Trichloroethene	10	80	130
Trichlorofluoromethane	10	80	101
1,2,3-Trichloropropane	10	80	110
1,1,2-Trichloro-1,2,2-trifluoroethane	10	80	151
Vinyl Chloride	10	80	62
m,p- Xylene	10	80	106
o-Xylene	10	80	106

Note:

The term Practical Quantitation Limit (PQL) refers to the laboratory's standard Reporting Limit.

* SW-846 Method Minimum Detectable Limits - ng reported are based on a 5 mL water equivalent.

3.0 SEMI-VOLATILE ORGANIC COMPOUNDS IN EXHAUST GAS

3.1 Summary QA/QC Criteria for SVOCs (0010 and 8270C)

QUALITY PARAMETER	METHOD/ FREQUENCY	CRITERIA	CORRECTIVE ACTION
Method Blank	1 per analytical batch	< PQL *	Reanalyze. Assess impact on data. Narrate.
Field Blank	1 per ATB	< PQL	Reanalyze and/or narrate.
Instrument Tune	Every 12 hours, initially and as required	As per 8270C	Retune instrument. Repeat DFTPP analysis.
Initial Calibration, Five Point	SPCC RRF	> 0.050	Evaluate system.
	CCC	$RSD \leq 30\%$	Recalibrate.
	Other compounds < 15% RSD	Average RF if 80% of the compounds meet the criteria	
Continuing Calibration	SPCC RRF	Same as initial	Evaluate system. Repeat calibration check.
	CCC	$RSD \leq 20\%$	Recalibrate. Reanalyze affected samples.
Internal Standards	RRT	± 30 seconds	Check sensitivity of system. Reanalyze standard.
	Accuracy	50 - 200%	
Precision/ Accuracy	LCS per batch	Historical lab data (See Table 3.2)	Check calculations. Reanalyze. Assess impact on data. Narrate.
	Surrogates	Historical lab data (See Table 3.2)	Check calculations. Reanalyze. Assess impact on data. Narrate.
PQL	Standard Compounds	10 µg/fraction	
Audit Sample	As Supplied	50-150%	
Holding Time		14 days to extraction 40 days to analysis	

Note:

The term PQL refers to the laboratory's standard Reporting Limit.

* Phthalate esters may be reported with qualifiers if the concentration of the analyte is less than five times the PQL; any such action must be addressed in the case narrative.

3.2 Historical Control Limits for SVOCs Method 0010 and 8270C

	COMPOUND	ACCURACY (% RECOVERY)	PRECISION RPD
DCS			
	Acenaphthene	57 to 113	20
	4-Chloro-3-methylphenol	42 to 126	29
	2-Chlorophenol	52 to 110	23
	1,4-Dichlorobenzene	50 to 108	22
	2,4-Dinitrotoluene	62 to 113	20
	4-Nitrophenol	10 to 145	73
	N-nitroso-di-n-propylamine	46 to 123	30
	Pentachlorophenol	11 to 135	125
	Phenol	20 to 119	24
	Pyrene	47 to 155	27
	1,2,4-Trichlorobenzene	49 to 112	20
Surrogates			
	1,2-Dichlorobenzene-d ₄	10 to 136	NA
	2-Fluorobiphenyl	35 to 122	NA
	2-Fluorophenol	10 to 108	NA
	Nitrobenzene-d ₅	15 to 118	NA
	Phenol-d ₅	10 to 121	NA
	Terphenyl-d ₁₄	35 to 120	NA
	2,4,6-Tribromophenol	10 to 154	NA

Notes:

Historical limits for the method are reported here. Current established limits will be used for the evaluation of the data as required by SW-846 (1).

RPD = Relative Percent Difference

DCS = Duplicate Control Samples

NA = Not Applicable

4.0 PCDDs/PCDFs SAMPLING AND ANALYSIS METHODS

4.1 Summary QA/QC Criteria for Dioxins by Method 0023A/8290

QUALITY PARAMETER	METHOD/FREQUENCY	CRITERIA	CORRECTIVE ACTION
Initial Calibration (ICAL)	Five-point calibration Initially and as required.	Natives RSD \leq 25%, except for OCDF < 30%	Evaluate system. Recalibrate.
Continuing Calibration (CCAL)	Midpoint standard at start of each 12 hour sequence	%D of natives \leq 25% from avg RRF (ICAL), except for OCDF < 30%	Evaluate system. Reanalyze CCAL. Recalibrate as necessary.
Reagent Blank	1 per batch	< 5 X PQL	Reanalyze and/or narrate.
Field Blank	1 per ATB	< 5 X PQL	Reanalyze and/or narrate.
Method Blank	1 per batch	< 5 X PQL	Reanalyze and/or narrate.
Window Defining Mix (WDM) Column Performance Standard Mixture (CPSM)	Once per 12 hours prior to sample analysis	Used to set retention times. CPSM must have \pm 25% valley resolution for 2,3,7,8-TCDD	Readjust windows. Evaluate system. Perform maintenance. Reanalyze WDM/CPSM.
Method Blanks	1 per analytical batch	< PQL, except for OCDD @ < 5 X PQL	Reanalyze if appropriate. Assess impact on data. Process archive sample if necessary.
LCS	1 per analytical batch	60 - 140% for target analytes	Review internal standards. Assess impact on data. Process archive sample if necessary.
Field Surrogates	Every sample	70 - 130%	Check chromatogram for interference. Assess impact on data and narrate.
Internal Standards	Every sample	40 - 135% for tetra through hexa isomers; 25 - 150% for hepta and octa isomers.	Check chromatogram for interference. Check instrument and reanalyze if necessary. Check signal-to-noise, if < 10:1, process archive sample. Assess impact on data and narrate.
Audit Sample	As Supplied	70-130%	
Holding Time		30 Days Extraction 45 Days Analysis	

Notes: The term PQL refers to the laboratory's standard Reporting Limit.

RSD = Relative Standard Deviation, OCDF = Octachlorodibenzofuran, RRF = Relative Response Factor,

%D = Percent Difference, TCDD = Tetrachlorodibenzo-p-dioxin, OCDD = Octachlorodibenzo-p-dioxin

4.2 Summary QA/QC Criteria for Dioxins by Method 8290

QUALITY PARAMETER	METHOD/ FREQUENCY	CRITERIA	CORRECTIVE ACTION
ICAL	Five point calibration Initially and as required.	Int Std RSD \leq 30% Natives RSD \leq 20%	Evaluate system. Recalibrate.
CCAL	Midpoint Standard at Start of Each 12 hour sequence	%D of IS \leq 30% from avg RRF (ICAL); %D of natives \leq 20% from avg RRF (ICAL).	Evaluate system. Reanalyze CCAL. Recalibrate as necessary.
WDM CPSM	Once per 12 hours prior to sample analysis.	Used to set retention times CPSM must have \leq 25% valley resolution for 2,3,7,8-TCDD	Readjust windows. Evaluate system. Perform maintenance. Reanalyze WDM/CPSM.
Method Blanks	1 per analytical batch	< PQL, except for OCDD @ < 5 X PQL	Reanalyze. Assess impact on data.
LCS	1 per analytical batch	60 - 140% for target analytes	Review internal standards. Assess impact on data. Reextract and/or reanalyze as necessary.
MS/MSD	1 per ATB	60 - 140% recovery for target analytes; RPD \leq 20%	Review LCS. Assess impact on data. Narrate.
Internal Standards	Every sample	40 – 135% for tetra through hexa isomers 25 – 150% for hepta and octa isomers	Check chromatogram for interference. Check instrument and reanalyze. Check signal-to-noise, if < 10:1, reextract. Assess impact on data and narrate.
Holding Time		30 Days Extraction 45 Days Analysis	

Note: The term PQL refers to the laboratory's standard Reporting Limit.

4.3 Practical Quantitation Limits for PCDDs/PCDFs

COMPOUND	METHOD 0023A/8290 (pg/Fraction)	METHOD 8290 (µg/kg)
2,3,7,8-TCDF	5	0.0005
1,2,3,7,8-PeCDF	25	0.0025
2,3,4,7,8-PeCDF	25	0.0025
1,2,3,4,7,8-HxCDF	25	0.0025
1,2,3,6,7,8-HxCDF	25	0.0025
1,2,3,7,8,9-HxCDF	25	0.0025
2,3,4,6,7,8-HxCDF	25	0.0025
1,2,3,4,6,7,8-HpCDF	25	0.0025
1,2,3,4,7,8,9-HpCDF	25	0.0025
OCDF	50	0.0050
2,3,7,8-TCDD	5	0.0005
1,2,3,7,8-PeCDD	25	0.0025
1,2,3,4,7,8-HxCDD	25	0.0025
1,2,3,6,7,8-HxCDD	25	0.0025
1,2,3,7,8,9-HxCDD	25	0.0025
1,2,3,4,6,7,8-HpCDD	25	0.0025
OCDD	50	0.0050

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5.0 VOLATILE TOTAL ORGANIC COMPOUNDS (0040)

5.1 Summary QA/QC Criteria for C₁ to C₈ Tedlar Bag Analysis

QUALITY PARAMETER	METHOD/ FREQUENCY	CRITERIA (6)	CORRECTIVE ACTION
Field Blanks	1 per Run	<5 X PQL	Clean System. Recollect Sample. Reanalyze.
Trip Blank	2 per SWDT	<5 X PQL	Determine Contamination Source. Reanalyze.
Laboratory Blank*	2 per SWDT, analyzed as required	<5 X PQL	Determine Contamination Source. Reanalyze.
Tedlar Bag Checks	Each bag used	<5 X PQL	Clean and Retest Bag
Initial Calibration	3 levels in duplicate	$r^2 > 0.995^{**}$	Recalibrate.
Continuing Calibration	RRT and RRF	$\pm 10\%$	Reanalyze. Recalibrate and Reanalyze affected samples.
LCS, Accuracy	1 per day	80 - 120%	Check System and Reanalyze. Recalibrate.
LCS, Precision	1 per day	< 20 RPD	Check System and Reanalyze.
Field Spike, Accuracy	1 per ATB	80 - 120%	Check System and Reanalyze.
Field Spike, Precision	1 per ATB	< 20 % RPD	Check System and Reanalyze.
PQL	Each Range	0.25 ppmv	
Holding Times	Tedlar Bag	2 Hours	

Note: The compounds will be summed up to and including Octane.

* Laboratory blank is analyzed only if the field and trip blanks fail criteria.

** This criteria is a goal only since no criteria is specified in the method.

5.2 Summary QA/QC Criteria for C₅ to C₈ Purge & Trap Analysis

QUALITY PARAMETER	METHOD/ FREQUENCY	CRITERIA (6)	CORRECTIVE ACTION
Method Blank	1 per Analytical Batch	< PQL	Reanalyze. Assess impact on data. Narrate.
Initial Calibration	C ₅ through C ₈ , 3 point injected in duplicate	RSD < 20%	Recalibrate.
Continuing Calibration	RRF RRT	15 % 3 sd	Recalibrate. Reanalyze affected samples.
Accuracy	LCS	80-120%	Check calculations. Reanalyze Assess impact on data. Narrate.
Precision	Duplicate	RPD < 50%	Check Calculations. Reanalyze Assess impact on data. Narrate.
Holding Time		14 days	

Note: All compounds with retention times < C₅ will be reported and quantitated as C₅. Compounds will be summed up to and including octane.

sd = standard deviation

6.0 SEMI-VOLATILE TOTAL ORGANIC COMPOUNDS (0010/TOC)

Summary QA/QC Criteria for SVTOCs C₈ to C₁₇ TCO Analysis

QUALITY PARAMETER	METHOD/ FREQUENCY	CRITERIA (6)	CORRECTIVE ACTION
Method Blank	1 per analytical batch	< 5 X PQL	Reanalyze. Assess impact on data. Narrate.
Field Blank	1 per SWDT	<5 X PQL	Reanalyze. Narrate.
Initial Calibration	C ₁₀ , C ₁₂ , and C ₁₄ *	RRF 20% RSD	Recalibrate.
Continuing Calibration	RRT and RRF	±15%	Recalibrate. Reanalyze affected samples.
Accuracy	DCS	50-150 % Recovery	Check calculations. Reanalyze. Assess impact on data.
Precision	DCS	RPD < 50 %	Check calculations. Reanalyze. Assess impact on data.
PQL		0.3 mg	
Holding Time		14 days	

Note: The term PQL refers to the laboratory's standard Reporting Limit.

Compounds will be summed above octane up to and including C₁₇.

* A 3-point calibration curve injected in duplicate will be analyzed to determine an average response factor for the C₈ to C₁₇ range.

7.0 NON-VOLATILE TOTAL ORGANIC COMPOUNDS (0010/GRAV.)

Summary QA/QC Criteria for Total Organics C₁₇ and higher TOC Gravimetric Analysis

QUALITY PARAMETER	METHOD/ FREQUENCY	CRITERIA (6)	CORRECTIVE ACTION
Method Blank	1 per analytical batch	< 5 X PQL	Reanalyze. Assess impact on data. Narrate.
Field Blank	1 per ATB	< 5 X PQL	Reanalyze. Narrate.
Accuracy	DCS	50-150 % Recovery	Check calculations. Reanalyze. Assess impact on data.
Precision	DCS	RPD 20%	Check calculations. Reanalyze. Assess impact on data.
Balance Accuracy	Analytical Balance Calibration	1.0 g ± 0.0005 g 5.0 g ± 0.0025 g	Recalibrate.
Audit Sample	As Supplied	80-120 %	
PQL		1.5 mg	
Holding Time		14 days	

Note: The term PQL refers to the laboratory's standard Reporting Limit.

8.0 HALIDE EMISSIONS

Summary QA/QC Criteria for Hydrogen Chloride and Chlorine (9057)

QUALITY PARAMETER	METHOD/ FREQUENCY	CRITERIA	CORRECTIVE ACTION
Method Blank	1 per analytical batch	< PQL ¹	Reanalyze. Assess impact on data. Narrate.
Field Blank	1 per SWDT	<Low standard	Narrate
Initial Calibration	4-point calibration and a blank. Initial/as required	Correlation coefficient > 0.995	Evaluate system. Recalibrate.
Continuing Calibration	Midpoint standard every 10 samples and at end of sequence	90 – 110%	Evaluate system. Repeat calibration check. Recalibrate. Reanalyze affected samples.
Precision/ Accuracy	LCS per batch	90 – 110%	Check calculations. Reanalyze. Assess impact on data. Narrate.
	MS/MSD per batch	85 – 115% %R, 25% RPD	Check calculations. If RPD is in control, accept data and narrate. If RPD is out of control, reanalyze.
Audit Sample	As provided	90 – 110%	Check calculations. Reanalyze and Narrate.
PQL	Hydrogen Chloride Chlorine	1.0 mg/train 1.0 mg/train	
Holding Time		28 days	

Note: The term PQL refers to the laboratory's standard Reporting Limit.

9.0 METHOD 6020 ICP/MS

9.1 Summary QA/QC Criteria

QUALITY PARAMETER	METHOD/FREQUENCY	CRITERIA	CORRECTIVE ACTION
Instrument Tune	Daily, prior to calibration and sample analysis	Mass resolution < 1.0 amu @ 10% peak height. Mass calib. ± 0.1 amu	Retune instrument. Repeat tune solution and analysis.
Initial Calibration	Blank and at least one standard.	ICV $\pm 10\%$ of expected value	Evaluate and reanalyze ICV Recalibrate.
Calibration Blank	After ICV and CCV	< PQL	Clean system. Rerun. Reanalyze affected samples.
CCV	Every 10 samples and end of run sequence	$\pm 10\%$ of expected value	Reanalyze CCV. Recalibrate. Reanalyze samples.
Method Blank	1 per analytical batch	<PQL	Reanalyze. Recalibrate as necessary.
Internal Standard	Each sample	30-130 % R	Reanalyze and/or narrate.
Duplicate Control Sample (DCS) *	1 per analytical batch	75% to 125% Recovery, RPD $\leq 25\%$	Check calculations. Assess impact on data. Reextract and reanalyze as necessary. Narrate.
Duplicate Analyses	1 per analytical batch	RPD $\leq 20\%$	Check calculations. Reanalyze. Assess impact on data
Holding Time		180 Days to analysis	

Note: amu = atomic mass unit

ICV = Initial Calibration Verification

CCV = Continuing Calibration Verification

* For air matrices, the QC samples per batch include a DCS only (no MS/MSD).

9.2 Method 6020 PQLs

ELEMENT	Metal Emissions, PQL (µg/Sample)	Aqueous Samples, PQL (mg/L)	Residue Samples, PQL (mg/kg)
Aluminum	7.5	NA	NA
Antimony	0.30	0.050	2.0
Arsenic	0.30	0.050	2.0
Barium	0.15	NA	NA
Beryllium	0.15	NA	NA
Boron	7.5	NA	NA
Cadmium	0.15	NA	NA
Chromium	0.30	NA	NA
Cobalt	0.15	NA	NA
Copper	0.30	NA	NA
Lead	0.15	0.025	1.0
Manganese	0.15	NA	NA
Nickel	0.30	NA	NA
Phosphorus	7.5	NA	NA
Selenium	0.45	0.050	2.0
Silver	0.15	NA	NA
Thallium	0.15	0.025	1.0
Tin	1.5	NA	NA
Vanadium	1.5	NA	NA
Zinc	0.75	NA	NA

NA = This element Not Analyzed by this method in this matrix.

10.0 MERCURY ANALYSIS METHODS (7470A/7471A)

Summary QA/QC Criteria

SW 846 Methods 7470A, 7471A and TCLP Mercury by Cold Vapor AAS

QUALITY PARAMETER	METHOD/ FREQUENCY	CRITERIA	CORRECTIVE ACTION
Initial Calibration	Blank and five standards. Daily before analysis	Corr. Coefficient \geq 0.995	Evaluate system. Recalibrate.
Calibration Blank	After ICV and each CCV	< PQL	Rerun. Clean system. Reanalyze affected samples.
ICV	After calibration	80-120%	Reanalyze ICV. Recalibrate.
CCV	Every 10 samples and end of run sequence	80-120%	Reanalyze. Recalibrate. Reanalyze affected samples.
Method Blank	1 per analytical batch	< PQL	Reanalyze. Recalibrate as necessary. Reanalyze.
LCS	1 per analytical batch	80-120% (aqueous) 75-125% (TCLP)	Check calculations. Reextract and reanalyze as necessary. Assess impact on data. Narrate.
MS/MSD	1 per analytical batch (20 samples).	75-125% (aqueous) 75-125% (TCLP)	Check calculations. Evaluate LCS. Assess impact on data.
Stack samples. MS on one FH fraction	1 per analytical batch	75-125%	Check calculations. Reanalyze. Assess impact on data.
Practical Quantitation Limit	Multiple Metals Train Aqueous Samples Solid Samples TCLP Extracts	0.2 μg /fraction 0.0002 mg/L 0.1 mg/kg 0.002 mg/L	
Holding Time		14 days See Table 7-1.	

Note: The term PQL refers to the laboratory's standard Reporting Limit.

11.0 VOLATILE ORGANIC COMPOUNDS IN PROCESS SAMPLES (8260B)

11.1 Summary of QC and Calibration Criterion for Method 8260B (Aqueous)

QUALITY PARAMETER	METHOD/FREQUENCY	CRITERIA	CORRECTIVE ACTION
Method Blank	1 per analytical batch	< PQL ¹	Reanalyze. Assess impact on data. Narrate.
Instrument Tune	Every 12 hours	Refer to method.	Retune instrument. Repeat BFB analysis.
Initial Calibration, Five point	SPCC RRF	> 0.10 Chloromethane > 0.10 1,1-DCA > 0.10 Bromoform > 0.30 Chlorobenzene > 0.30 1,1,2,2-TCA	Evaluate system. Recalibrate.
	CCC	RSD ≤ 30%	
	Compounds < 15% RSD	Average RF if 80% of the compounds meet the criteria	
Continuing Calibration	SPCC RRF	Same as initial	Evaluate system. Repeat calibration check.
	CCC	< 20% drift	Recalibrate. Reanalyze affected samples.
	Every 12 hours	RSD ≤ 50% for non-CCCs ²	Evaluate system. Repeat calibration check.
Internal Standards	RRT	≤ 0.50 or 30 seconds	Check sensitivity of system. Reanalyze standard.
	Recovery	50 – 200%	
Precision/ Accuracy	LCS per batch	Historical lab data (See Table 11.2)	Check calculations. Reanalyze. Assess impact on data. Narrate.
	MS/MSD per batch	Historical lab data (See Table 11.2)	Check calculations. Analyze LCS. Assess impact on data.
	Surrogates	Historical lab data (See Table 11.2)	Check calculations. Reanalyze. Assess impact on data. Narrate.
Holding Time		14 days	

Note: The term PQL refers to the laboratory's standard Reporting Limit.

¹ Except for common lab contaminants: methylene chloride, acetone, and 2-butanone may be reported with qualifiers if the concentration of the analyte is less than five times the PQL. Such action must be addressed in the case narrative.

² Allowance for up to 6 target analytes ≥ 50%.

11.2 Control Limits for Process Samples by Method 8260B

	COMPOUND	ACCURACY (% RECOVERY)	PRECISION RPD
LCS			
	1,1-Dichloroethene	66 to 130	NA
	Benzene	77 to 121	NA
	Trichloroethene	75 to 116	NA
	Toluene	78 to 120	NA
	Chlorobenzene	80 to 120	NA
MS/MSD			
	1,1-Dichloroethene	66 to 130	32
	Benzene	77 to 121	21
	Trichloroethene	75 to 116	24
	Toluene	78 to 120	25
	Chlorobenzene	80 to 120	20
Surrogates			
	1,2-Dichloroethane-d4	64 to 139	NA
	Toluene-d8	72 to 128	NA
	4-Bromofluorobenzene	66 to 121	NA

Notes: Historical limits for the method are reported here. Current established limits will be used for the evaluation of the data as required by SW-846 (1).

NA = Not Applicable

11.3 Summary of QC and Calibration Criterion for Method 8260B (TCLP)

QUALITY PARAMETER	METHOD/FREQUENCY	CRITERIA	CORRECTIVE ACTION
Method Blank	1 per analytical batch	< PQL ¹	Reanalyze. Assess impact on data. Narrate.
Instrument Tune	Every 12 hours	Refer to method.	Retune instrument. Repeat BFB analysis.
Initial Calibration, Five point	SPCC RRF	> 0.10 Chloromethane > 0.10 1,1 DCA > 0.10 Bromoform > 0.30 Chlorobenzene > 0.30 1,1,2,2 TCA	Evaluate system. Recalibrate.
	CCC	RSD ≤ 30%	
	Special	Special ²	
Continuing Calibration	Every 12 hours	RSD ≤ 50% for non-CCCs ³	Evaluate system. Repeat calibration check. Recalibrate. Reanalyze affected samples.
	SPCC RRF	Same as initial	
	CCC	< 20% drift	
Internal Standards	RRT	≤ 0.50 or 30 seconds	Check sensitivity of system. Reanalyze standard.
	Recovery	50 - 200% (Sample to Std.) ⁴	
Precision/ Accuracy	LCS per batch	Historical lab data. (See Table 11.2.)	Check calculations. Reanalyze. Assess data. Narrate.
	MS/MSD per batch	Historical lab data. (See Table 11.2.)	Check calculations. Analyze LCS. Assess impact on data.
	Surrogates	Historical lab data. (See Table 11.2.)	Check calculations. Reanalyze. Assess data. Narrate.
Holding Time		14 days	

Note: The term PQL refers to the laboratory's standard Reporting Limit.

¹ Except for common lab contaminants: methylene chloride, acetone, and 2-butanone may be reported with qualifiers if the concentration of the analyte is less than five times the PQL. Such action must be addressed in the case narrative.

² For Compounds > 15% RSD, use a quadratic fit, all others use average RRF.

³ Allowance for up to 6 target analytes ≥ 50%.

⁴ Internal standard recovery is measured from sample to the daily standard.

12.0 SEMI-VOLATILE ORGANIC COMPOUNDS IN PROCESS SAMPLES

12.1 Summary of SVOC QC and Calibration Criterion for Method 8270C

QUALITY PARAMETER	METHOD/FREQUENCY	CRITERIA	CORRECTIVE ACTION
Method Blank	1 per analytical batch	< PQL *	Reanalyze. Assess data, Narrate.
Instrument Tune	Every 12 hours, initially and as required	As per 8270C	Retune instrument. Repeat DFTPP analysis.
Initial Calibration, Five point	SPCC RRF	≥ 0.050	Evaluate system. Recalibrate.
	CCC	$RSD \leq 30\%$	
	Compounds < 15% RSD	Average RF if 80% of the compounds meet the criteria	
Continuing Calibration	SPCC RRF	Same as initial	Evaluate system. Repeat calibration check.
	CCC	$RSD < 20\%$	Recalibrate. Reanalyze affected samples.
Internal Standards	RRT	± 30 seconds	Check sensitivity of system. Reanalyze standard.
	Accuracy	50 – 200%	
Precision/Accuracy	LCS per batch	Historical lab data (See Table 12.2)	Check calculations. Reanalyze. Assess data, Narrate.
	MS/MSD per batch.	Historical lab data (See Table 12.2)	Check calculations. Analyze LCS. Assess impact on data.
	Surrogates	Historical lab data (See Table 12.2)	Check calculations. Reanalyze. Assess data, Narrate.
PQL		0.050 mg/L to 0.25 mg/L	
Holding Time		Extraction – 14 days Analysis – 40 days	

Note: The term PQL refers to the laboratory's standard Reporting Limit.

* Except for common lab contaminants: Phthalate esters may be reported with qualifiers if the concentration of the analyte is less than five times the PQL. Such action must be addressed in the case narrative.

**12.2 Historical Control Limits for Method 8270C
for Semi-Volatile Organic Compounds in Aqueous Samples**

	COMPOUND	%R AQUEOUS
LCS	Acenaphthene	62 to 103
	4-Chloro-3-methylphenol	60 to 100
	2-Chlorophenol	48 to 102
	1,4-Dichlorobenzene	51 to 91
	2,4-Dinitrotoluene	60 to 113
	4-Nitrophenol	18 to 63
	N-nitroso-di-n-propylamine	61 to 105
	Pentachlorophenol	35 to 118
	Phenol	16 to 56
	Pyrene	47 to 126
	1,2,4-Trichlorobenzene	57 to 97

	COMPOUND	%R AQUEOUS	RPD AQ
MS/MSD	Acenaphthene	59 to 103	15
	4-Chloro-3-methylphenol	60 to 100	26
	2-Chlorophenol	48 to 102	34
	1,4-Dichlorobenzene	51 to 91	29
	2,4-Dinitrotoluene	60 to 113	26
	4-Nitrophenol	18 to 63	67
	N-nitroso-di-n-propylamine	61 to 105	26
	Pentachlorophenol	35 to 118	39
	Phenol	16 to 56	71
	Pyrene	47 to 126	36
	1,2,4-Trichlorobenzene	57 to 97	27
Surrogates	2-Chlorophenol-d ₄	25 to 101	NA
	1,2-Dichlorobenzene-d ₄	49 to 99	NA
	2-Fluorobiphenyl	47 to 106	NA
	2-Fluorophenol	10 to 70	NA
	Nitrobenzene-d ₅	50 to 102	NA
	Phenol-d ₅	10 to 47	NA
	Terphenyl-d ₁₄	40 to 125	NA
	2,4,6-Tribromophenol	21 to 127	NA

Note: Historical limits for the method are reported here. Current established limits will be used for the evaluation of the data as required by SW-846 (1).

13.0 METALS ANALYSIS BY ICP (6010B)

13.1 Method 6010B Calibration and QC Criteria

QUALITY PARAMETER	METHOD/ FREQUENCY	CRITERIA	CORRECTIVE ACTION
Initial Calibration	Calibration blank and one standard. Daily prior to analysis	$\pm 5\%$ RSD	Evaluate system. Recalibrate.
Calibration Blank	After initial calibration and each calibration	$< \text{PQL}$	Clean system. Rerun. Reanalyze affected samples.
ICP Interference Check	Run at beginning of daily run; after 8 hours and/or end of run	80-120%	Verify calibration. Update IECs. Recalibrate.
ICV	After calibration	$\pm 10\%$ of expected response	Reanalyze ICV. Recalibrate.
CCV	Every 10 samples and end of run sequence	$\pm 10\%$ of expected response	Reanalyze CCV. Recalibrate. Reanalyze affected samples.
Method Blank	1 per analytical batch	$< \text{PQL}^1$	Reanalyze. Recalibrate as necessary.
LCS *	1 per analytical batch	Aqueous %R : 80 to 120% TCLP %R : 75 to 125%	Check calculations. Reextract and reanalyze as necessary. Assess data, Narrate.
MS/MSD ²	1 per analytical batch.	$\text{RPD} \leq 20\%$	Check calculations. Analyze LCS. Assess impact on data.
Holding Time		28 days for unpreserved samples see Table A-7-1.	

Note: The term PQL refers to the laboratory's standard Reporting Limit.

* The QC batching for aqueous and TCLP matrices includes an LCS and MS/MSD.

13.2 Method 6010B PQLs

ELEMENT	Aqueous Samples, PQL (mg/L)	TCLP Samples, PQL (mg/L)	Residue Samples, PQL (mg/kg)
Aluminum	0.50	NA	100
Antimony	NA	NA	NA
Arsenic	NA	NA	NA
Barium	0.025	0.5	5.0
Beryllium	0.010	0.010	2.0
Boron	0.50	NA	100
Cadmium	0.010	NA	2.0
Chromium	0.025	NA	5.0
Cobalt	0.025	NA	5.0
Copper	0.025	NA	5.0
Lead	NA	NA	NA
Manganese	0.025	NA	5.0
Nickel	0.025	0.025	10.0
Selenium	NA	NA	NA
Silver	0.025	NA	5.0
Thallium	NA	NA	NA
Tin	0.10	NA	20.0
Vanadium	0.025	0.025	5.0
Zinc	0.025	0.025	5.0

NA = This element Not Analyzed by this method in this matrix.

14.0 SUMMARY QA/QC CRITERIA FOR AGENT PURITY (TE-LOP-584)

QUALITY PARAMETER	METHOD/ FREQUENCY	CRITERIA	CORRECTIVE ACTION
Initial Calibration	Average RF	RSD < 25%	Evaluate System. Recalibrate.
Instrument Tune	Every 12 hours	As per 8270C	Retune Instrument. Repeat DFTPP analysis.
Continuing Calibration Check (QL)	Every 12 hours	± 15% for HD ± 25% for Impurities	Evaluate System. Repeat Calibration of System. Recalibrate. Reanalyze affected samples.
Internal Standards	Recovery	50 – 200%	Check Sensitivity of system. Reanalyze sample.
Duplicate Samples	RPD	≤ 35 %	Reanalyze duplicate samples and narrate.
PQL	HD Q T DCE DTA	200 µg/mL 5.0 µg/mL 5.0 µg/mL 5.0 µg/mL 5.0 µg/mL	
Holding Time		30 days	

Notes:

HD = *bis*(2-chloroethyl) sulfide

Q = 1,2-*Bis*(2-chloroethylthio)ethane

T = *bis*[2-(2-chloroethylthio)ethyl] ether

DCE = 1,2-dichloroethane

DTA = 1,4-dithiane

15.0 DAAMS TUBE ANALYSIS (TE-LOP-562)

Summary QA/QC Criteria for DAAMS Tube Analyses

QUALITY PARAMETER	METHOD/ FREQUENCY	CRITERIA	CORRECTIVE ACTION
Method Blank	Analyzed with calibration standards	< PQL	Reanalyze. Assess impact on data. Narrate.
Initial Calibration		Correlation Coefficient >0.995	Recalibrate.
Accuracy (QL)	2 per sample batch	± 15% %R for > 0.3 ng; ±35% %R for ≤ 0.3 ng	Check calculations. Reanalyze QL. Reanalyze CS and recalibrate if necessary. Reanalyze QL. Assess impact on data.
Field Surrogate (QP Sample)	1 per DAAMS set	± 40% Recovery	Analyze a QL to verify instrument operation.
PQL	Agent GB Agent VX Mustard	0.0216 ng 0.0180 ng 1.5 ng	
Holding Time		72 hours	

Note: The term PQL refers to the laboratory's standard Limit of Quantitation.

16.0 REFERENCES

- (1) *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, 3rd Edition including Update III, USEPA, SW-846, December 1996.
- (2) Title 40, *Code of Federal Regulations*, Part 60, Appendix A, “Test Methods”.
- (3) Title 40, *Code of Federal Regulations*, Part 136, Appendix A, “Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater”.
- (4) *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, November 1999.
- (5) *Handbook: Quality Assurance/Quality Control (QA/QC) Procedures for Hazardous Waste Incineration*, EPA/625/6-89/023, January 1990.
- (6) *Guidance for Total Organics*, Final Report, EPA/600/R-96-036, March 1996.

MUSTARD AGENT TRIAL BURN PLAN

FOR THE

LIQUID INCINERATORS

APPENDIX A

ANNEX B

EXAMPLE DATA FORMS

REVISION 1

April 6, 2006

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Annex B - 1

Project No. _____
Operator Initials _____

PM/HCl/Cl₂
EPA Method 5
SW-846 Method 0050

Run No. _____
Condition no. _____
Date: _____

Moisture Determination

Imp No.	Contents	Volume (mL)	Configuration	Final Wt (g)	Initial Wt. (g)	Net Gain (g)
1	0.1 N H ₂ SO ₄	50	KO	-	-	=
2	0.1 N H ₂ SO ₄	100	GS	-	-	=
3	0.1 N H ₂ SO ₄	100	GS	-	-	=
4	0.1 N NaOH	100	Mod	-	-	=
5	0.1 N NaOH	100	Mod	-	-	=
Annex B	Silica Gel	~ 300g	Mod	-	-	=
				Total Net Gain (g) =		

Sample Recovery Checklist

AT LOCATION

_____ Rinse and brush probe and nozzle three times with acetone into PNR bottle.

_____ Rinse the transfer line three times with water into the Acid Impinger (AcIdImp) bottle.

IN LABORATORY

_____ Separate filter holder and place filter in clean pre-rinsed , glass petri dish. Complete filter (Filt) sample label.

_____ Rinse front half of filter holder with acetone into PNR bottle. Complete probe and nozzle rinse (PNR) sample label.

_____ Rinse back half of filter holder with deionized water into the Acid Impinger (AcIdImp) bottle.

Sample Log

Sample ID Number	No. of Sample Containers	Description
TOCDF-MPF-Stk-____-M5-PNR		Probe and Nozzle Rinse
TOCDF-MPF-Stk-____-M5-Filt		Filter
TOCDF-MPF-Stk-____-M0050-AcIdImp		Acid Impinger Catch
TOCDF-MPF-Stk-____-M0050-AlkImp		Alkaline Impinger Catch

_____ Disassemble sample train, wipe off excess water and weigh each impinger. Record the final weights in the Moisture Determination section.

_____ Pour contents of 1st, 2nd and 3rd (containing acid) impingers into the Acid impinger catch bottle(s). Rinse impingers and connecting glassware with deionized water into the same bottle(s). Complete Acid Impinger (AcIdImp) Sample Label.

_____ Pour the contents of the 5th and 6th impingers (containing NaOH) into the alkaline impinger catch bottle(s). Rinse impingers and connecting glassware with deionized water into the same bottle(s). Complete alkaline impinger (AlkImp) sample label.

_____ Log samples into logbook and store appropriately

[illegible]

Annex B -

Moisture Determination

Imp No.	Contents	Volume (mL)	Configuration	Final Wt (g)	Initial Wt. (g)	Net Gain (g)
1	-	-	K/O	-	-	=
2	Nitric/Peroxide	100	Mod	-	-	=
3	Nitric/Peroxide	100	GS	-	-	=
4	-	-	Mod	-	-	=
5	KMnO ₄ Soln	100	Mod	-	-	=
6	KMnO ₄ Soln	100	Mod	-	-	=
7	Silica Gel	~ 300g	Mod	-	-	=
				Total Net Gain (g) =		

Annex B

Sample Recovery Checklist

AT LOCATION

- _____ Rinse and brush probe and nozzle with 0.1 N nitric acid into PNR bottle. Note – use teflon brush
- _____ Rinse the transfer line three times with 0.1 N nitric acid into NI bottle.

IN LABORATORY

- _____ Separate filter holder and place filter in clean petri dish. Complete Filt sample label.
- _____ Rinse front half of filter holder with 0.1 N nitric acid into PNR bottle. Complete PNR sample label. Note: Exactly 100 mL of 0.1 N nitric acid will be used in the PNR rinse.
- _____ Disassemble sample train, wipe off excess water and weigh each impinger. Record the final weights in the Moisture Determination section.
- _____ Pour contents of first 3 impingers into the Nitric/peroxide impinger (NI catch bottle(s)). Rinse the impingers and connecting glassware with 0.1 N nitric acid into the NI bottle(s). Rinse the back half of the filter holder with 0.1 N nitric acid into this sample bottle as well. Complete the NI sample label(s). Note exactly 250 mL of 0.1 N nitric acid will be used in the NI rinse.
- _____ Rinse the 4th (initially empty) impinger with 100 mL 0.1 N nitric acid into the empty impinger rinse (EIR) bottle. Complete EIR sample label.
- _____ Pour the contents of the 5th and 6th impingers (permanganate impingers) into the permanganate impinger catch bottle (Perm). Rinse with 100 ml of permanganate solution and then 100 mL DI water. Complete Perm sample label
- _____ Rinse the permanganate impingers with a total of 25 mL of 8 N HCl. Rinse the permanganate impingers with 200 mL DI water. Complete HClRns sample label. (Note, this is not required if there is no visible solid residue)
- _____ Log samples into logbook and store appropriately.

[illegible]

6

Project No. _____
Operator Initials _____

Semi-Volatile Organics SW-846 – Method 0010

Run No. _____
Condition no. _____
Date: _____

Moisture Determination

Impinger No.	Contents	Volume (mL)	Configuration	Final Wt (g)	- Initial Wt. (g)	= Net Gain (g)
1	-	-	KO		-	=
2	H ₂ O	100	Mod		-	=
3	H ₂ O	100	GS		-	=
4	-	-	Mod		-	=
5	Silica Gel	~ 300g	Mod		-	=
6					-	=
7					-	=
				Total Net Gain (g) =		

Annex B

Sample Recovery Checklist

AT LOCATION

_____ Rinse and brush probe and nozzle with 50:50 mixture of methylene chloride and methanol into PNR bottle.

_____ Rinse transfer line with 50:50 mixture of methylene chloride and methanol into CR bottle.

IN LABORATORY

_____ Separate filter holder and place filter in clean pre-rinsed, glass petri dish. Complete Filt sample label.

_____ Seal XAD trap ends. Complete XAD sample label.

_____ Rinse front half of filter holder with 50:50 mixture of methylene chloride and methanol into PNR bottle. Complete PNR label.

_____ Rinse coil condenser, back half of filter holder and all connecting glassware between the filter and XAD with 50:50 mixture of methylene chloride and methanol into the CR (condenser rinse) bottle. Complete CR sample label.

_____ Disassemble train, wipe off excess water and weigh impingers.
_____ Record final weights in Moisture Determination section.

_____ Pour contents of impingers into the Cond (condensate catch) bottle(s). Rinse the impingers and connecting glassware with HPLC water into the Imps bottle(s). Complete Cond sample label.

_____ Rinse the impingers and connecting glassware with 50:50 methylene chloride/methanol three times into the IR (impinger rinse) bottle(s). Complete IR sample label.

_____ Log samples into logbook and place in refrigerator or ice chest.

Sample Log

Sample ID Number	No. of Sample Containers	Description
TOCDF-MPF-Sik-____-M0010-PNR		Probe and Nozzle Rinse
TOCDF-MPF-Sik-____-M0010-Filt		Filter
TOCDF-MPF-Sik-____-M0010-CR		Condenser Rinse
TOCDF-MPF-Sik-____-M0010-XAD		XAD
TOCDF-MPF-Sik-____-M0010-Cond		Condensate Catch
TOCDF-MPF-Sik-____-M0010-IR		Impinger Rinse

Project No. _____
Operator Initials _____

Total Organic Emissions SW-846 – Method 0010-TOE

Run No. _____
Condition no. _____
Date: _____

Moisture Determination

Impinger No.	Contents	Volume (mL)	Configuration	Final Wt (g)	Initial Wt. (g)	Net Gain (g)
1	-	-	KO	-	-	=
2	H ₂ O	100	Mod	-	-	=
3	H ₂ O	100	GS	-	-	=
4	-	-	Mod	-	-	=
5	Silica Gel	~ 300g	Mod	-	-	=
6				-	-	=
7				-	-	=
				Total Net Gain (g) =		

Sample Log

Sample ID Number	No. of Sample Containers	Description
TOCDF-MPF-Sik-____-M0010-TOE-PNR		Probe and Nozzle Rinse
TOCDF-MPF-Sik-____-M0010-TOE-Filt		Filter
TOCDF-MPF-Sik-____-M0010-TOE-CR		Condenser Rinse
TOCDF-MPF-Sik-____-M0010-TOE-XAD		XAD
TOCDF-MPF-Sik-____-M0010-TOE-Cond		Condensate
TOCDF-MPF-Sik-____-M0010-TOE-IR		Impinger Rinse

Sample Recovery Checklist

AT LOCATION

- ____ Rinse and brush probe and nozzle with 50:50 mixture of methylene chloride and methanol into PNR bottle.
- ____ Rinse transfer line with 50:50 mixture of methylene chloride and methanol into CR bottle.

IN LABORATORY

- ____ Separate filter holder and place filter in clean pre-rinsed, glass petri dish. Complete Filt sample label.
- ____ Seal XAD trap ends. Complete XAD sample label.
- ____ Rinse front half of filter holder with 50:50 mixture of methylene chloride and methanol into PNR bottle. Complete PNR sample label.
- ____ Rinse coil condenser, back half of filter holder and all connecting glassware between the filter and XAD with 50:50 mixture of methylene chloride and methanol into the CR (condenser rinse) bottle. Complete CR sample label.
- ____ Disassemble sample train, wipe off excess water and weigh each impinger. Record the final weights in the Moisture Determination section.
- ____ Pour contents of impingers into the Cond (condensate catch) bottle(s). Rinse the impingers and connecting glassware with HPLC water into the Cond bottle(s).
- ____ Rinse impingers with 50:50 methylene chloride/methanol three times into the IR (impinger rinse) bottle(s). Complete IR sample label.
- ____ Log samples into logbook and place in refrigerator or ice chest.

Nozzle Calib. _____

[illegible]

Annex B -

Project No. _____
Operator Initials _____

Dioxins and Furans

SW-846 – Method 0023A

Run No. _____
Condition no. _____
Date: _____

Moisture Determination

Impinger No.	Contents	Volume (mL)	Config-uration	Final Wt (g)	- Initial Wt. (g) =	Net Gain (g)
1	-	-	K/O	-	-	=
2	H ₂ O	100	G/S	-	-	=
3	H ₂ O	100	Mod	-	-	=
4	Silica Gel	~ 300g	Mod	-	-	=
5				-	-	=
6				-	-	=
Annex B - 11				Total Net Gain (g) =		

Sample Log

Sample ID Number	No. of Sample Containers	Description
TOCDF-MPF-Stk-____-M0023A-PNR		Probe and Nozzle Rinse
TOCDF-MPF-Stk -____-M0023A-Filt		Filter
TOCDF-MPF-Stk -____-M0023A-CR		Condenser Rinse
TOCDF-MPF-Stk -____-M0023A-XAD		XAD

Sample Recovery Checklist

AT LOCATION

____ Rinse and brush the probe liner and nozzle into the PNR bottle: three times with acetone, twice with methylene chloride, and twice with toluene.

____ Rinse transfer line three times with acetone, twice with methylene chloride, twice with toluene into CR bottle.

IN LABORATORY

____ Separate filter holder and place filter in clean pre-rinsed, glass petri dish. Complete Filt sample label.

____ Seal XAD trap ends. Complete XAD sample label.

____ Rinse front half of filter holder into PNR bottle: three times with acetone, twice with methylene chloride, twice with toluene. Complete PNR sample label.

____ Disassemble sample train, wipe off excess water and weigh each impinger. Record the final weights in the Moisture Determination section. DISCARD the impinger solution.

____ Rinse the back half of the filter holder, all connecting glassware and the coil condenser: three times with acetone, twice with methylene chloride and twice with toluene. Complete the CR sample label.

____ Log samples into logbook and place in refrigerator or ice chest.

Sample Type – Volatile Organics - Method 0031	Start Time	Condition	Page _____ of _____
Plant Name – TOCDF	End Time	Run	Bar. Press. (in. Hg)
Project Number –	Date	DGMCF	Elev. (Rel. to Bar.) (ft)
Location (Source) – MPF	Operator	Console No.	Amb. Temp (°F)

Pair No.	of	Tube Identification No.	Temperatures (°F)						Vacuum ("Hg)
Clock Time		Gas Volume (L)	Meter Pressure ("H2O)	Probe	Meter In	Meter Out	1st Cond.	2nd Cond.	

Leak Checks ("Hg)	Pre-Test	Comments
	Post Test	

Pair No.	of	Tube Identification No.	Temperatures (°F)						Vacuum ("Hg)
Clock Time		Gas Volume (L)	Meter Pressure ("H2O)	Probe	Meter In	Meter Out	1st Cond.	2nd Cond.	

Leak Checks ("Hg)	Pre-Test	Comments
	Post Test	

Pair No.	of	Tube Identification No.	Temperatures (°F)						Vacuum ("Hg)
Clock Time		Gas Volume (L)	Meter Pressure ("H2O)	Probe	Meter In	Meter Out	1st Cond.	2nd Cond.	

Leak Checks ("Hg)	Pre-Test	Comments
	Post Test	

Pair No.	of	Tube Identification No.	Temperatures (°F)						Vacuum ("Hg)
Clock Time		Gas Volume (L)	Meter Pressure ("H2O)	Probe	Meter In	Meter Out	1st Cond.	2nd Cond.	

Leak Checks ("Hg)	Pre-Test	Comments
	Post Test	

Project No. _____
Operator Initials _____

Volatile Organic Compounds

SW-846 – Method 0031

Run No. _____
Condition no. _____
Date: _____

Sample Log

Sample ID Number	Description
TOCDF-MPF-Stk-____-M0031-Set1-TnxA	Tenax Tube – A – Set 1
TOCDF-MPF-Stk-____-M0031-Set1-TnxB	Tenax Tube – B – Set 1
TOCDF-MPF-Stk-____-M0031-Set1-Ansb	Anasorb – Set 1
TOCDF-MPF-Stk-____-M0031-Set2-TnxA	Tenax Tube – A – Set 2
TOCDF-MPF-Stk-____-M0031-Set2-TnxB	Tenax Tube – B – Set 2
TOCDF-MPF-Stk-____-M0031-Set2-Ansb	Anasorb - Set 2
TOCDF-MPF-Stk-____-M0031-Set3-TnxA	Tenax Tube – A – Set 3
TOCDF-MPF-Stk-____-M0031-Set3-TnxB	Tenax Tube – B – Set 3
TOCDF-MPF-Stk-____-M0031-Set3-Ansb	Anasorb – Set 3
TOCDF-MPF-Stk-____-M0031-Set4-TnxA	Tenax Tube – A – Set 4
TOCDF-MPF-Stk-____-M0031-Set4-TnxB	Tenax Tube – B – Set 4
TOCDF-MPF-Stk-____-M0031-Set4-Ansb	Anasorb – Set 4
TOCDF-MPF-Stk-____-M0031-FB-TnxA	Tenax Tube – A – Set Blk
TOCDF-MPF-Stk-____-M0031-FB-TnxB	Tenax Tube – B – Set Blk
TOCDF-MPF-Stk-____-M0031-FB-Ansb	Anasorb – Set Blk
TOCDF-MPF-Stk-____-M0031-Condensate	Condensate – 40 ml Vial
TOCDF-MPF-Stk-____-M0031-Condensate-Bk	Condensate Blank – 40 ml Vial

Sample Recovery Checklist

____ Transfer VOST condensate into VOA vial. After fourth pair fill vial to capacity (no air bubbles) with HPLC water. Complete Sample Label for Condensate

____ Fill a different VOA vial with HPLC Water. Complete Sample Label for Condensate Blank

____ Reseal both Tenax tubes with provided caps and return to shipping container. Complete sample labels.

____ Reseal each Anasorb tube with provided caps and return to shipping container. Complete sample label.

____ Wrap each set of tubes in a ziplock baggie.

____ Log samples into logbook and store on ice.

[illegible]

Project No. _____
Operator Initials _____

Total Organics

SW-846 – Method 0040

Run No. _____
Condition no. _____
Date: _____

Sample Log

Sample ID Number	Description
TOCDF-MPF-Stk-____-0040-Bag	Tedlar Bag
TOCDF-MPF-Stk-____-0040-Cond	Condensate – 40 mL VOA Vial

Annex B
15

Sample Recovery Checklist

- ____ Transfer condensate into VOA vial. Rinse condensate catch into VOA vial, and fill vial to capacity (no air bubbles) with HPLC water. Complete Sample Label for Condensate
- ____ Disconnect tedlar bag and cap the inlet to the bag.
- ____ Take bag sample to GC for onsite analysis.
- ____ Log condensate sample into logbook and store on ice.

Project No. _____
Operator Initials _____

Total Organics
SW-846 – Method 0040

Run No. _____
Condition no. _____
Date: _____

Sample Log

Sample ID Number	Description
TOCDF-MPF-Stk-____-0040-Bag-Blk	Tedlar Bag
TOCDF-MPF-Stk-____-0040-Cond-Blk	Condensate Blank-- 40 mL VOA Vial

Sample Recovery Checklist

- ____ Fill a VOA vial with HPLC Water. Complete Sample Label for Condensate Blank
- ____ Disconnect tedlar bag and cap the inlet to the bag.
- ____ Take bag sample to GC for onsite analysis.
- ____ Log condensate samples into logbook and store on ice.

URS Source Sampling Temperature Readout Calibration Form
Per Reference _____

Operator _____
 Date _____

Readout ID Number _____
 Thermometer ID Number _____
 Voltage Generator ID Number _____

Temperature Readout Calibration	
Thermometer (°F) _____	Temperature Readout (°F) (after adjustment) _____

Temperature Readout Calibration Check										
Channel	Voltage (mV)	Temperature (°F)				Channel	Voltage (mV)	Temperature (°F)		
		Theoretical	Observed	Difference¹				Theoretical	Observed	Difference
1	0.0	32				5	-1.0	-10		
	1.0	77					0.0	32		
	3.0	165					1.0	77		
	7.0	341					2.0	121		
	15.0	692					3.0	165		
2	0.0	32				6	-1.0	-10		
	3.0	165					0.0	32		
	4.0	208					1.0	77		
	5.0	251					2.0	121		
	7.0	341					3.0	165		
3	0.0	32				7	-1.0	-10		
	3.0	165					0.0	32		
	4.0	208					1.0	77		
	5.0	251					2.0	121		
	7.0	341					3.0	165		
4	-1.0	-10								
	0.0	32								
	1.0	77								
	2.0	121								
	3.0	165								

Five-Point Dry Gas Meter Calibration Form (Against Critical Orifice)

Console ID _____ Date: _____ Signature: _____

		Run 1A	Run 1B	Run 2A	Run 2B	Run 3A	Run 3B	Run 4A	Run 4B	Run 5A	Run 5B		
Critical Orifice	Identification Number												
	K Factor												
	Subject DGM	DGM Initial Reading (ft ³)											
		DGM Final Reading (ft ³)											
		Temperature (°F)	Inlet Initial										
			Outlet Initial										
		Inlet Final											
		Outlet Final											
	Test Time (minutes)												
	Orifice Manometer, ΔH (″ H ₂ O)												
Barometric Pressure (″ Hg)													
Ambient Temperature (°F)													
Pump Vacuum (″ Hg)													

Annex B -

Notes:

Three-Point Dry Gas Meter Calibration Form (Against Critical Orifice)

Console ID _____ Date: _____ Signature: _____

Critical Orifice		Run 1A	Run 1B	Run 2A	Run 2B	Run 3A	Run 3B	
DGM Calibration	Identification Number							
	K Factor							
	Subject DGM	DGM Initial Reading (ft³)						
		DGM Final Reading (ft³)						
		Temperature (°F)	Inlet Initial					
			Outlet Initial					
			Inlet Final					
	Outlet Final							
	Annex B - 19	Test Time (minutes)						
		Orifice Manometer, ΔH (" H ₂ O)						
Barometric Pressure (" Hg)								
Ambient Temperature (°F)								
	Pump Vacuum (" Hg)							
Check the readout against a NIST Thermometer		Check the readout linearity (one channel only)						
NIST Thermometer ID _____		Voltage Supply ID _____			Channel No _____			
Thermometer Reading (°F)		Voltage (mv)			Theoretical (°F)			
Readout Reading (°F)		0			Observed (°F)			
		1			Difference (°F)			
		3						
		7						
		15						
Temperature Readout Calibration		692						

DGM Calibration	
Console ID	Operator Signature
Nominal Orifice Flow Rate	Date

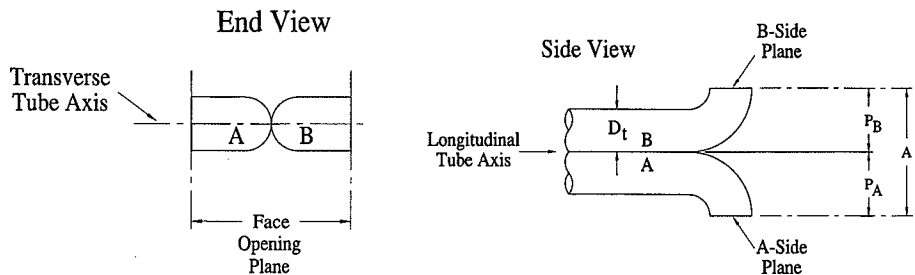
Thermocouple Calibration	
Thermometer ID	Voltage Supply ID

Modified 12 January 2004

S-Type Pitot Tube Inspection Sheet

Inspector: _____ Date: _____ Pitot ID: _____

General Pitot Tube Alignment



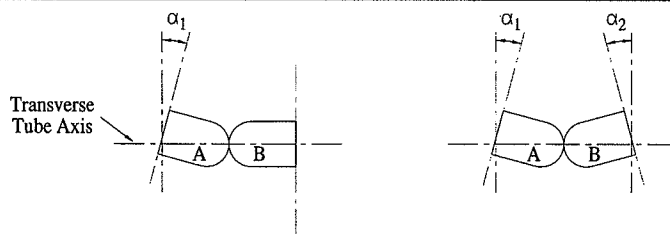
A = _____

D_t = _____

$0.188'' \leq D_t \leq 0.375''$? _____ (y/n)

$1.05 \leq \frac{A}{2D_t} \leq 1.50$? _____ (y/n)

Misalignment

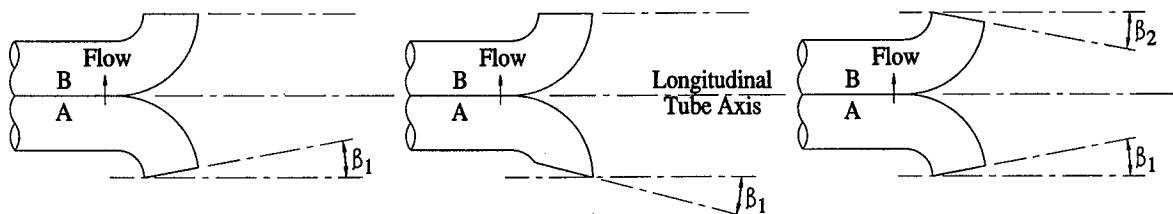


α_1 = _____

α_2 = _____

$\alpha_1 \leq 10^\circ$? _____ (y/n)

$\alpha_2 \leq 10^\circ$? _____ (y/n)

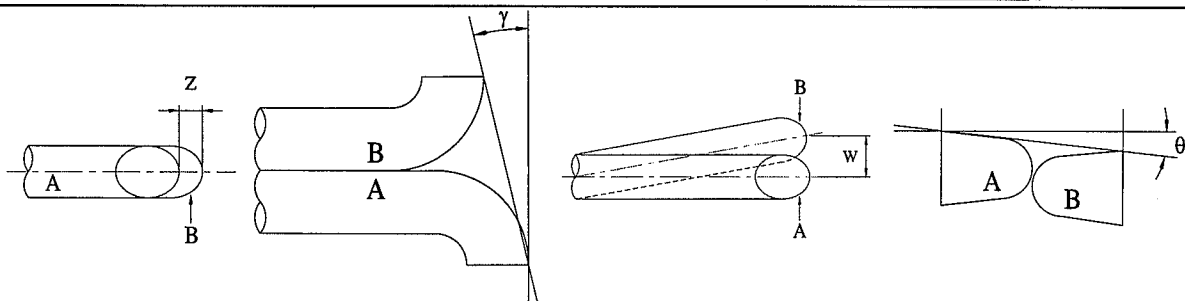


β_1 = _____

β_2 = _____

$\beta_1 \leq 5^\circ$? _____ (y/n)

$\beta_2 \leq 5^\circ$? _____ (y/n)



γ = _____ $Z = A \tan(\gamma)$ = _____

θ = _____ $W = A \tan(\theta)$ = _____

$Z \leq 0.125''$? _____ (y/n)

$W \leq 0.031''$? _____ (y/n)

Acceptability for Use (Circle Selection)

If all answers are "y", this pitot tube is available for use, and could be assigned a correction factor of 0.84

If all answers except the first (D_t) are "y", this pitot tube is available for use, but needs to be calibrated using a wind tunnel.

Any other situation, the pitot tube must be removed from service.

Pitot Tube Calibration Data Sheet

Pitot Tube Identification Number: _____ Date: _____

Calibrated by: _____

Run No.	“A” Side Calibration			Deviation $C_{p(s)} - \text{Avg } C_p$
	ΔP_{std} (in. water)	ΔP_s (in. water)	$C_{p(s)}$	
1				
2				
3				
Average $C_{p(s)}$ (Side A)				

Run No.	“B” Side Calibration			Deviation $C_{p(s)} - \text{Avg } C_p$
	ΔP_{std} (in. water)	ΔP_s (in. water)	$C_{p(s)}$	
1				
2				
3				
Average $C_{p(s)}$ (Side B)				

$$C_{p(s)} = C_{p(std)} \times \sqrt{\frac{\Delta P_{std}}{\Delta P_s}} \quad C_{p(std)} = 0.99$$

$$\text{Average Deviation} = \sigma_{(a \text{ or } b)} = \sum_{i=1}^3 \left(\frac{C_{p(s)} - C_{p(s)i}}{3} \right) \quad \text{Must be } \leq 0.01$$

$$\text{Difference} = \left| \text{Average } C_{p(s)a} - \text{Average } C_{p(s)b} \right| \quad \text{Must be } \leq 0.01$$

Portable Barometer Calibration Data Sheet

Portable Barometer Identification _____

Date _____

Operator _____

Laboratory barometer reading (reference) (in Hg)	
Portable barometer reading after correction (in Hg)	
Difference between reference and portable after correction (in Hg)	
Is the difference $\leq \pm 0.1$ in Hg (yes/no)	

BALANCE CALIBRATION

Balance ID _____ Date _____

Initial Calibration	Calibration Weight		Operator
	ID #	Mass	

Linearity Check	Calibration Weight		Balance Reading	Acceptable Range
	ID #	Mass		
		100		99.9 - 100.1
		200		199.8 - 200.2
		500		499.5 - 500.5
		1000		999 - 1001

<p>Calibration of Student Weights</p> <p>Student Weight Set ID _____</p>	Calibration Weight	Balance Reading

FIELD BALANCE CALIBRATION

Balance ID _____ Date _____

Operator _____

Calibration Check of Balance Using Student Weights Student Weight Set ID _____	Student Calibration Weight ^a	Actual Mass (from Annual Calibration)	Balance Reading	Difference	Percent Difference ^b

^a Use only calibration weights greater than 20 g.

^b The acceptance criteria for percent difference is $\pm 0.5\%$. This is calculated using this equation:

$$\text{Percent Difference} = \frac{\text{balance reading} - \text{actual mass}}{\text{actual mass}} \times 100$$

Sensitivity Check ^c

Primary Weight (1000 g Class 1 Calibration Weight)	Balance Reading A	Secondary Weight (1 g Class 1 Calibration Weight)	Balance Reading B	Balance Reading of Secondary Weight (Balance Reading B – Balance Reading A)	% of Secondary Weight ^d

^c In order to complete the sensitivity check of the field balance a weight greater than or equal to 1000 g is placed on the balance and the balance reading is recorded. Then a second weight less than or equal to 1 g is also placed on the balance. This second balance reading is recorded.

^d The acceptance criteria for the sensitivity check is 85-115% of the secondary weight. This is calculated using this equation:

$$\% \text{ of Secondary Weight} = \frac{\text{Balance reading B} - \text{Balance Reading A}}{\text{Secondary Weight}} \times 100$$

URS CEMS Operation Log

Project	Page	of
Project Number	Operator	
Source	Date	

[illegible]

SAMPLE LINE TEST DATA SHEET

1. Station Number: _____
2. Signature and ID# of operator performing the test:

3. Is the Sample line associated with an ACAMS/DAAMS? (circle one or both)
4. Date/Time^{C5} of Sample Line Test: _____
5. If test is performed with an ACAMS record Serial # here: _____ - _____ - _____
6. DAAMS port sample line challenge was performed through _____
7. If test is performed with a DAAMS tube, record the following information:
Line Test tube # _____ Blank Test tube # _____ DSCR # _____
8. Agent of interest: (GB, VX, or HD) circle one Concentration _____ µg/mL
9. Solution ID Number: _____

<u>OPERATION TO BE PERFORMED</u>	CHECK CORRECT BOX	
Permission for test from Control Room	GIVEN BY	
Visual inspection of sample line of interest	PASS	FAIL
Heat Trace Operational	PASS	FAIL
Target Concentration ^{C4}	1.0 ^{C4}	
Result of the Sample Line Test – 1 st Challenge		
Result of the Sample Line Test – 2 nd Challenge (if necessary)		
Corrective Action (if necessary)		
Challenge After Corrective Action (if needed)		
Passing Recovery must be ± 40% of Target Concentration (1.0 Z) ^{C4} ORR 420-2	%Recovery ORR 420-2	

_____/_____
Signature of Person Completing Record Job Title

_____/_____
Signature of Person Reviewing Record Job Title

ACAMS CALIBRATION DATA SHEET

DATE	
TIME	
UNIT NUMBER	
STATION NUMBER	
OPERATOR	
AGENT	GB HD VX
CONCENTRATION MODE	STEL VSL ECL IDLH SEL
STANDARD SOLUTION	
PARAMETERS	VALUE
CAL H* (BEFORE CALIBRATION)	
PMT VOLTAGE (BEFORE CALIBRATION)	
CONCENTRATION READOUT AFTER FIRST INJECTION	
CARRYOVER READOUT (0.20Z OR LESS)	
CONCENTRATION READOUT BETWEEN 0.90Z AND 1.10Z AFTER SECOND INJECTION	
CARRYOVER READOUT (0.20Z ^{C5} OR LESS)	
(CAL H Range 5 – 60)	
CAL H* (AFTER CALIBRATION)	
1.0 Z CHALLENGE AFTER CALIBRATION	
CARRYOVER READOUT (0.20Z OR LESS)	
LOQ CHALLENGE AFTER CALIBRATION (IF APPLICABLE)	

This form replaces the previous calibration form dated: _____

_____ / _____ Signature of Person Completing Record Job Title	_____ / _____ Signature of Person Reviewing Record Job Title
---	--

FM-PRPMO001-05.R1C7

THIS DOCUMENT IS A RECORD

ACAMS DAILY OPERATIONAL LOG

Station:			Agent: GB VX HD			Serial #		
Date:			Time:			Operator ID#:		
STEL	SEL	VSL	ECL	IDLH	Ave. Sample Flow			Vial #
Chart Speed 16cm/h		Y	N	Heat Trace Hot?		N2 desiccant _____% depleted (approx.)		NOTE If desiccant exceeds 75% depletion, it <u>must</u> be changed out.
Red/Black Pens Legible?		Y	N	Alarm Set Point		Air desiccant _____% depleted (approx.)		
ACAMS Cart Regulator Pressure (must be between 50 – 70) N2 _____ Air _____ H2 _____						H2 desiccant _____% depleted (approx.)		
CHALLENGE DATA								
1 st 1Z Chall		PDARS:		P1 / F1	Carryover: 0.20Z or less	LOQ:	PDARS:	Agent Gate —
2 nd 1Z Chall		PDARS:		P2 / F2	Carryover: 0.20Z or less	LOQ:	PDARS:	
CORRECTIVE ACTIONS								
Changed V/G Pad: Y N		Changed PCT: Y N		Calibrate: Y N		Blow Lines: Y N		<input type="checkbox"/> See Comm.
<input type="checkbox"/> Move Agent Gate		As Per Mon Lead M# _____				New Agent Gate: - 1Z chall after gate move: _____		Retention Time
1Z Chall After Corrective:		PDARS:		P / P2 / P3	Carryover:	LOQ:	PDARS:	
POST CHALLENGE CHECKS								
Is V-G pad changed out on sample line?						Y	N	N/A See Comm.
Is sample line connected to the ACAMS?						Y	N	N/A See Comm.
Is the ACAMS audible alarm connected <u>or</u> is there a tag indicating disconnection?						Y	N	N/A See Comm.
Does the sample line error switch and the ACAMS malfunction Light work properly?						Y	N	N/A See Comm.
Is ret. time at least 3 sec. after gate opens and at least 5 sec. before it closes?						Y	N	N/A See Comm.
Does the strip chart contain the following information?						<div style="border: 1px solid black; padding: 2px;"> "Z" value reading, agent, Concentration Mode, Pass or Fail Status, Time, Date, Operator ID, Station ID Number, Carryover – LOQ & Pass or Fail (if applicable) </div>		
Have all pertinent actions been recorded in associated Logs?						Y	N	N/A See Comm.
CIM is in: (circle one): Operate Calibrate Service Challenge Station Not in PDARS								
Comments: _____ _____ _____ _____								
<div style="display: flex; justify-content: space-between; margin-bottom: 10px;"> <div>_____ Signature of Person Completing Record Job Title</div> <div>_____ Signature of Person Reviewing Record Job Title</div> </div> THIS DOCUMENT IS A RECORD								

ACAMS Dilution Flow Readings

Circle One
GB VX HD
92/8 95/5 95/5

Station Number _____
Date _____

Technician _____
Time _____
ADC # _____

Readings Before Adjustment

% Dilution, Dial Setting = _____
ADC Sample Flow Rate = _____ mL/min
Sample Flow Rate at End of Probe = _____ mL/min
Ratio = Dilution Flow Rate % _____ Sample Flow Rate % _____ = 100%

System Leak Check Performed _____ (Done while probe is pulled.)
Technician's Initials

Readings After Adjustment

% Dilution, Dial Setting = _____
ADC Sample Flow Rate = _____ mL/min

NOTE

The difference between the above flow rate and the ACAMS Sample Average may not exceed 100 mL/min.

Sample Flow Rate at End of Probe = _____ mL/min
Ratio = Dilution Flow Rate % _____ Sample Flow Rate % _____ = 100%

Probe has been replaced into the proper sampling location, and all system components are functioning properly. _____

Technician Signature

_____/_____
Signature of Person Preparing Record Job Title

_____/_____
Signature of Person Reviewing Record Job Title

*If readings (before adjustment) are off by more than 1% twice in a 2 month period the Team Lead will be notified. The Team Lead will report this variance and any corrective actions to the Monitoring Manager.

DAAMS Dilution Flow Readings

Circle One
GB VX HD
92/8 95/5 95/5

Station Number _____
Date _____

Technician _____
Time _____
DDC# _____

Readings Before Adjustment

% Dilution, Dial Setting = _____
DDC Sample Flow Rate = _____ L/min
Sample Flow Rate at End of Probe = _____ mL/min
Ratio = Dilution Flow Rate % _____ Sample Flow Rate % _____ = 100%

System Leak Check Performed _____ (Done while the probe is pulled.)
Technician's Initials

Readings After Adjustment

% Dilution, Dial Setting = _____
DDC Sample Flow Rate = _____ L/min
Sample Flow Rate at End of Probe = _____ mL/min
Ratio = Dilution Flow Rate % _____ Sample Flow Rate % _____ = 100%

Probe has been replaced into the proper sampling location and all systems components are functioning properly. _____
Tech. Signature

_____/_____
Signature of Person Preparing Record Job Title

_____/_____
Signature of Person Reviewing Record Job Title

*If readings (before adjustment) are off by more than 1% twice in a 2 month period the Team Lead will be notified. The Team Lead will report this variance and any corrective actions to the Monitoring Manager.

FM-PRPMO001-03.R2C0

THIS DOCUMENT IS A RECORD

DAAMS SAMPLE COLLECTION RECORD (DSCR)

SAMPLE ID# _____ AGENT _____ DATE _____ METHOD: _____

ACAMS Cycle Time _____ ANALYZE ☐ DESORB ONLY ☐ PRIORITY ☐ NORMAL ☐
(if applicable)

STATION ID#	TUBE #	BEG. FLOW LPM	BEG. ASP DATE/TIME	DISTRIB. TECH ID	END FLOW LPM	COLLECT. TECH I.D.	ASP. END DATE/TIME	COMMENTS

Chain-of-Custody

FROM: _____ DATE/TIME: _____ TO: _____ DATE/TIME: _____

FROM: _____ DATE/TIME: _____ TO: _____ DATE/TIME: _____

FROM: _____ DATE/TIME: _____ TO: _____ DATE/TIME: _____

FROM: _____ DATE/TIME: _____ TO: _____ DATE/TIME: _____

FROM: _____ DATE/TIME: _____ TO: _____ DATE/TIME: _____

Signature of Person Completing Record Job Title

Signature of Person Reviewing Record Job title

MUSTARD AGENT TRIAL BURN PLAN

FOR THE

LIQUID INCINERATORS

APPENDIX A

ANNEX C

RESUMES OF KEY INDIVIDUALS

REVISION 1

April 6, 2006

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URS CORPORATION PERSONNEL RESUMES

Michael Fuchs
Margaret Duncan
Carl Galloway
Adam Blank
Robert Woytek
Michael Thomas
Chris Weber
Kevin McGinn
Steve Hall
Andy Hodgson
Jacob Oaxaca
Dave Maxwell
Eugene Youngerman
Lori Rodriguez
Don Burrows
German José Arellano

URS KEY PERSONNEL

Michael Fuchs

PROPOSED PROJECT ASSIGNMENT: Project Manager, Onsite Field Team Leader

Mr. Fuchs is a Principal Project Manager primarily focusing on projects dealing with hazardous waste treatment and disposal. He has over 25 years experience as a hazardous waste consultant. In addition, he has over 15 years experience dealing with permitting issues for TSCA, RCRA, and BIF incinerators. Mr. Fuchs has been involved in the development of trial burn plans and Quality Assurance Project Plans, conduct of trial burns, and the preparation of trial burn reports. Mr. Fuchs is working with strategies for the implementation of MACT rules at various facilities. He also manages and participates in the conduct of trial burns, and he has been involved in trial burns at the Department of Energy facilities in Savannah River and the Idaho National Engineering and Environmental Laboratory. He has been involved in programs to de-list various hazardous waste streams.

EDUCATION/SPECIALIZED TRAINING

B.S., Chemistry, Southwest Texas State University, San Marcos, TX

Margaret Duncan

PROPOSED PROJECT ASSIGNMENT: Assistant Project Manager and Sample Recovery

Ms. Duncan has experience performing various types of source emissions testing. Her experience has been with both manual methods and instrumental methods. She has performed extensive testing involved in EPA Methods 1-5, 26, and 29. In addition, she has conducted continuous priority pollutant analyses and on-site gas chromatography analysis of hydrocarbons, fixed gases, and sulfur species. Ms. Duncan has been involved in trial burn data reduction and report writing. She has experience in laboratories with sample preparation, sample extraction, and sample control. Ms. Duncan has conducted QA/QC data validations and review of laboratory data, and she has experience with CEMS testing and certifications.

EDUCATION/SPECIALIZED TRAINING

B.A., Chemistry, Southwestern University, Georgetown, TX

OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Carl Galloway**PROPOSED PROJECT ASSIGNMENT:** Method 0040

Mr. Galloway has performed various types of instrumental analysis and wet chemical tests pertaining to flue gas desulfurization (FGD) systems, boiler operations, petrochemical processes, synthetic fuels generations, and waste incineration. He has also participated in field sampling and analysis of flue gases; wastewater treatment systems; and solid, liquid, and gas process streams. He has experience in the operation and maintenance of CEMS and ambient air sampling equipment. Mr. Galloway has been involved in the operation, maintenance, and analytical support of bench-scale investigations of FGD systems and cooling tower models. He has been involved in analytical method development for various projects. In addition, he has developed methods for FGD monitoring. He has also been involved in method development for synthetic fuel gas systems, incineration monitoring systems, and fugitive emissions monitoring systems.

EDUCATION/SPECIALIZED TRAINING

B.A. Biology, University of Texas, Austin, TX

OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Adam Blank**PROPOSED PROJECT ASSIGNMENT:** Field Technician

Mr. Blank has experience in laboratory testing and source testing. He has developed methods for monitoring production facilities, and he has experience with the EPA methods used to characterize exhaust gases at various incineration facilities. In addition, he has been involved in several field sampling events where exhaust gas samples have been used to characterize emissions from various types of emission sources.

EDUCATION/SPECIALIZED TRAINING

B.A., Bio-Psychology, Tufts University, Boston, MA

OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Robert Woytek**PROPOSED PROJECT ASSIGNMENT:** Method 0031 Sample Train

Mr. Woytek is a Research Assistant for the Process and Environmental Services Department of the Austin, Texas home office. Mr. Woytek has ten years experience in environmental testing for air-related programs. Mr. Woytek's responsibilities at URS include the calibration, mobilization, and demobilization of source testing equipment used on air emission programs. His experience includes source sampling using EPA reference method procedures, equipment fabrication, and laboratory analysis. He has been involved in several field sampling activities at a variety of facilities.

EDUCATION/SPECIALIZED TRAINING

Attended Austin Community College, Austin, TX

OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Michael Thomas**PROPOSED PROJECT ASSIGNMENT:** Sample Recovery

Mr. Thomas is a chemist on the staff of the URS Analytical and Electronic Services Group. His main areas of experience include Fourier Transform Infrared Spectroscopy (FTIR), extractive sampling of process and stack gas using FTIR spectroscopy, and various laboratory techniques for analyzing gaseous samples. He has conducted sampling of VOCs and acid gases in support of operating facilities and has performed extractive sampling at various chemical and petrochemical facilities. He has experience running multiple EPA methods and isokinetic sampling. In addition, he has been involved in sampling setup, sample collection, sample preparation, and sample recovery.

EDUCATION/SPECIALIZED TRAINING

B.S., Chemistry, University of Texas, Austin, TX

OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Chris Weber**PROPOSED PROJECT ASSIGNMENT:** Field Technician

Mr. Weber has worked in laboratory and field sampling. He has experience with the EPA methods used to characterize exhaust gases from various incineration facilities. He has been involved in several field-sampling events where exhaust gas samples have been used to characterize emissions from various types of sources.

EDUCATION/SPECIALIZED TRAINING

B.S., Biology, Vanderbilt University, Nashville, TN

OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Kevin McGinn**PROPOSED PROJECT ASSIGNMENT:** CEMS Technician

Mr. McGinn specializes in air quality monitoring where he has nine years experience. He has managed projects in chemical demilitarization, waste incineration, cement production, and chemical industries. He has served as the project manager on trial burns, risk burns, and comprehensive performance tests. He has been involved in the development of trial burn plans, QAPPs, and project reports. In addition, he has been involved in several field-sampling events to characterize various exhaust gas emissions.

EDUCATION/SPECIALIZED TRAINING

B.S., Chemistry, McGill University, Montreal, Quebec, Canada

OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Steve Hall**PROPOSED PROJECT ASSIGNMENT:** Field Technician

Mr. Hall is a chemist on the staff of the URS Analytical and Electronic Services Group. His main areas of experience include Fourier Transform Infrared Spectroscopy (FTIR), extractive sampling of process and stack gas using FTIR spectroscopy, and various laboratory techniques for analyzing gaseous samples. He has conducted sampling of VOCs and acid gases in support of operating facilities, and he has performed extractive sampling at various chemical and petrochemical facilities. In addition, he has experience running multiple EPA methods and isokinetic sampling.

EDUCATION/SPECIALIZED TRAINING

B.S. Chemistry, University of Texas, Austin, TX

OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Andrew R. Hodgson**PROPOSED PROJECT ASSIGNMENT:** Field Technician

Mr. Hodgson has experience in air quality testing. He has experience with the EPA methods used to characterize exhaust gases from various incineration facilities, and he has experience conducting audits of air quality monitoring systems. He has also performed data validation on gas chromatography data.

EDUCATION/SPECIALIZED TRAINING

B.S., Environmental Science, Lehigh University, Bethlehem, PA
OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Jacob Oaxaca**PROPOSED PROJECT ASSIGNMENT:** Field Technician

Mr. Oaxaca has experience in source testing and with the EPA methods used to characterize exhaust gases from various incineration facilities. In addition, he has been involved in several field sampling events where exhaust gas samples have been used to characterize emissions from various types of emission sources.

EDUCATION/SPECIALIZED TRAINING

B.S., Chemistry, University of Texas, Austin, TX
OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Dave Maxwell**PROPOSED PROJECT ASSIGNMENT:** Sample Collection

Mr. Maxwell is an analytical chemist with 20 years experience in the characterization of chemical and industrial processes, source emissions test programs, ambient air monitoring, environmental analyses, and high-purity water treatment. His project experience focuses on the testing existing, and developing new, fossil fuel technologies; the development and application of chemical measurement methods; and the analysis of emissions from hazardous waste incineration and other waste treatment systems. Mr. Maxwell has experience in laboratory method development for complex industrial processes. He has been involved in the preparation of trial burn plans, QAPPs, and project reports. He has been involved in several field sampling events where exhaust gas samples have been used to characterize emissions from various types of emission sources. Mr. Maxwell has several publications relating to his project experience.

EDUCATION/SPECIALIZED TRAINING

B.S., Chemistry, University of Southern California, Los Angeles, CA
OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Eugene Youngerman, Ph.D.**PROPOSED PROJECT ASSIGNMENT:** Field Support and Report Development

Dr. Youngerman currently serves as a Senior Staff Scientist. His responsibilities include the direction of, and participation in, permitting and testing activities of hazardous waste incinerators, as well as other source testing directed toward process characterization or regulatory compliance. He has nine years experience in this area including document preparation; test protocol design and preparation; plan implementation; and interpretation and reporting of sampling, analysis, and QA/QC results. He has served as Project Director on major sampling and analysis programs for RCRA and TSCA pre-trial burn tests and trial burns. Dr. Youngerman has several publications relating to his experience on various projects.

EDUCATION/SPECIALIZED TRAINING

Ph.D., Chemistry, University of California, San Diego, CA
M.S., Chemistry, University of California, San Diego, CA
B.S., Chemistry, Massachusetts Institute of Technology, Cambridge, MA
OSHA 40-Hour Hazardous Waste Site Health and Safety Training

Lori Rodrigues**PROPOSED PROJECT ASSIGNMENT:** Field Support and Report Development

Ms. Rodrigues currently serves as a Staff Scientist for the Measurements Group of Austin's General Engineering Sector. Her primary responsibility is as lab manager for the Inorganic Analytical Lab and Sample Preparation Lab. Ms. Rodrigues' experience includes the operation and maintenance of various laboratory instrumentation. She has participated in analytical methods development, internal research and development projects, and field sampling. In addition, she has been a Project Chemist for several pollution control projects and other field projects.

EDUCATION/SPECIALIZED TRAINING

B.S., Chemistry, University of Texas, Austin, TX

OSHA 40-Hour Hazardous Waste Site Health and Safety Training

OSHA 29 CFR Supervisor Trained

Don B. Burrows**PROPOSED PROJECT ASSIGNMENT:** Quality Assurance

Mr. Burrows is presently working the Ambient Air Monitoring Section in the Measurements Unit of URS Austin General Engineering. His responsibilities pertain to quality systems associated with environmental measurement programs. He has extensive experience in all types of environmental measurement programs and quality management systems pertaining to those programs. He has served as the quality manager for several laboratories and field projects. He has experience developing project plans and Quality Assurance Project Plans. Mr. Burrows has conducted audits and data validation studies for laboratory projects. He has several publications in the area of environmental monitoring and quality control.

EDUCATION/SPECIALIZED TRAINING

B.S., Chemistry, Angelo State University, San Angelo, TX

OSHA 40-Hour Hazardous Waste Site Health and Safety Training

German José Arellano

PROPOSED PROJECT ASSIGNMENT: GC Operator, Method 0040

Mr. Arellano has over five years of experience in the chemical industry performing research functions, using various EPA and State of Texas environmental protocols, and the ISO-9001 certified quality system. His comprehensive knowledge of chemical and scientific processes includes an emphasis in mass spectrometry and FT-IR, as well as other spectroscopic and chromatographic techniques. In addition, Mr. Arellano has teaching and supervisory experience.

EDUCATION/SPECIALIZED TRAINING

M.S., Analytical Chemistry, University of Wisconsin, Madison, WI

B.S., Chemistry, University of Texas, Austin, TX

SEVERN TRENT LABORATORY

PERSONNEL RESUMES

Robert Weidenfeld
Patrick G. Rainey
Karla S. Buechler
Steven D. Rogers
Michael Flournoy
Pamela A. Schemmer
David J. Herbert
Clark A. Pickell
Barry Votaw
Steven D. Rogers
Michael Flournoy

SEVERN TRENT LABORATORY KEY PERSONNEL

Karla S. Buechler

Laboratory Director

Ms. Buechler has over 20 years of experience in the environmental industry with 12 years in various managerial positions and eight years of hands-on experience with pesticide extraction and gas chromatography. Ms. Buechler is responsible for the overall operation of the West Sacramento laboratory, which includes advanced technology and environmental services group. Ms. Buechler directs laboratory quality assurance, health and safety, and compliance programs. Ms. Buechler has served as the Laboratory Operations Manager and the Manager and Technical Director for Advanced Technology Operations.

ACADEMIC AND PROFESSIONAL DEGREES

B.S., Biochemistry, University of California, Davis, CA

Patrick G. Rainey

Technical Director, Operations Manager – Air Toxics

Mr. Rainey has over 17 years in environmental testing and directs all sample preparation activities for samples undergoing analysis in support of the ambient and source sampling programs at STL Sacramento. He manages the day-to-day operations in the air toxics area, which handles the media preparation, extraction, and analysis of organic and inorganic parameters for air samples collected in support of ambient and source sampling programs. He interacts closely with the clients, laboratory project managers, and laboratory operations staff to develop sampling and analysis plans. In addition, Mr. Rainey has served as both a preparation chemist and instrument analyst.

ACADEMIC AND PROFESSIONAL DEGREES

B.S., Environmental Toxicology, University of California, Davis, CA

Steven D. Rogers**Advanced Technology Instruments Department
Manager/Volatiles**

Mr. Rogers has over 20 years of management and bench-level experience. He is currently managing the High-Resolution Mass Spectroscopy department where analyses for dioxins and PCB congeners are performed. He performs technical data reviews, operates HRGC/HRMS and LRMS instruments, and creates and reviews standard area operating procedures and Quality Assurance Project Plans. In addition, Mr. Rogers provides technical expertise in all organics areas of the laboratory.

ACADEMIC AND PROFESSIONAL DEGREES

BS, Biochemistry/Biophysics, Oregon State University, Corvallis, OR

Michael Flournoy**Laboratory Operations Manager**

Mr. Flournoy has over 16 years of experience in the environmental industry with 6 years in various managerial positions and 15 years of hands-on experience with High Resolution extraction and gas chromatography/mass spectrometry. He oversees High Resolution and Low Resolution extraction, GC Semivolatile extraction, and GCMS Semivolatile extraction groups in the laboratory. In addition, Mr. Flournoy is responsible for client satisfaction, financial management, human resources, health and safety program compliance and quality assurance plan compliance.

Robert Weidenfeld**Project Manager**

Mr. Weidenfeld brings over 13 years of experience to the project manager position. He is particularly knowledgeable of the special requirements of multi-metal air sampling trains. He utilizes his experience and expertise to recommend the most cost-effective analytical approaches while considering the overall program requirements. Mr. Weidenfeld manages projects that require air toxics analyses. He ensures that the client's requirements are communicated to the laboratory and reviews final data packages for compliance. In addition, he serves as a technical resource for clients planning and executing air-sampling programs.

ACADEMIC AND PROFESSIONAL DEGREES

B.S., Agricultural Management, University of California, Berkeley, CA

Pamela A. Schemmer**Quality Assurance Manager**

Ms. Schemmer brings more than 10 years of experience in the analytical industry to her current role as Quality Assurance Manager. She began her career as an analyst and quickly advanced into management positions with increasing responsibility. Ms. Schemmer directs and monitors quality assurance activities at the West Sacramento facility. She is responsible for reports to management, client concerns resolution, project plan review, lab performance review, and review of procedures that will ensure the production of data of a defined quality.

ACADEMIC AND PROFESSIONAL DEGREES

B.S., Chemistry, University of Iowa, Iowa City, IA

David J. Herbert**Manager of Customer Service**

Mr. Herbert has 14 years of experience in the environmental laboratory business. Mr. Herbert manages all aspects of laboratory support, including project management, sample administration, data reporting, and information technology. He works closely with the sales staff to support new opportunities and client management. Mr. Herbert is also active in application development for laboratory automation and improved efficiency. He routinely applies his computer expertise gained in GC/MS operations to streamline production and enhance the STL customer interface.

ACADEMIC AND PROFESSIONAL DEGREES

B.S., Biochemistry, California Polytechnic State University, San Luis Obispo, CA

Clark A. Pickell**Lead Chemist**

Mr. Pickell's seven years with the company have been in the Advanced Technology Group in West Sacramento. He currently holds the position of Lead Chemist. He is trained in the operation of the high-resolution GC/MS instruments, VG-70, and autospec instruments. Mr. Pickell is also responsible for preparation of standards for calibration curves and daily working dilutions. He is trained in preparing all media for sampling (e.g., PUFs, filters, bottles and jars), waste stream tracking, and waste disposal. Mr. Pickell is experienced in data write-up and reduction and prepares hard copy and electronic data deliverables using Opusquan and LIMS software.

ACADEMIC AND PROFESSIONAL DEGREES

B.S., Physics, minor Math/Engineering, California State University, Chico, CA

Barry Votaw**Senior Scientist**

Mr. Votaw is responsible for analyses and data review in the metals area. Mr. Votaw has 22 years of experience with metals analyses and is experienced in all inorganic laboratory analyses, specializing in the metals area with AA and ICP (including furnace AA, flame or hydride AA, and both sequential and simultaneous ICP). His expertise includes all EPA-CLP methodologies and quality assurance requirements for inorganic analyses. Mr. Votaw also supervises method development in various matrices.

ACADEMIC AND PROFESSIONAL DEGREES

M.S., Water Science and Engineering, University of California, Davis, CA

B.S., Renewable Natural Resources, University of California, Davis, CA

Air Toxics, Ltd., Personnel Resumes

Linda L. Freeman
Brad Mosakowski
Heidi C. Hayes
Melanie Levesque
Nathan Shafer
Jeffrey Tecson
Ausha Scott
Susan Alaniz
Noor Khan
Jeet Grewal
Maisie Watson

Air Toxics, Ltd., Key Personnel

Linda L Freeman

**Chief Executive Officer And Laboratory
(Technical) Director (1)**

Ms. Linda L. Freeman is the Technical Director and the Chief Executive Officer of ATL, providing leadership to ensure that the founding mission and core values of the company are put into practice. Ms. Freeman leads programs relating to the development of long-range strategy, quality systems, and financial infrastructure. As Technical Director (1), her responsibilities include: providing administrative review of laboratory operations and qualifications for technical positions, ensuring and documenting initial and ongoing proficiency, and overseeing Quality systems. Ms. Freeman has 20 years of combined environmental experience and 16 years of laboratory business management experience.

ACADEMIC AND PROFESSIONAL DEGREES:

M.S., Analytical Chemistry-Toxicology, University of WI-Madison, Madison, WI

B.S., Analytical Chemistry, Boston College, Boston, MA

Brad Mosakowski

President

Mr. Mosakowski is the President of ATL and represents the partnership in all matters. Mr. Mosakowski provides day-to-day leadership and program management for overseeing the processes and resources necessary for establishing long-range service objectives, plans, and policies, in cooperation with the CEO and Board of Managers. He is responsible for the measurement and effectiveness of both internal and external processes by providing accurate and timely feedback on the operating condition of the company. In addition, Mr. Mosakowski also directs the definition and operation of the laboratory production by fostering accountability and a success-oriented environment. A critical component of which is his ability to motivate and lead a high-performance management team capable of meeting both customer service and bottom line financial objectives. Mr. Mosakowski has 15 years of combined environmental laboratory experience.

ACADEMIC AND PROFESSIONAL DEGREES:

A.A., Liberal Arts, Diablo Valley College, Pleasant Hill, CA

Certificate, Crystalline Electron Microscopy, San Joaquin Delta College, Stockton, CA

Heidi C. Hayes**Vice President, Director Of Business Development
and Technical Director (2)**

Ms. Hayes is the Vice President, Director of Business Development and Technical Director (2) of ATL, and is responsible for developing sustainable customer relations by providing customized solutions through technical leadership in marketing, sales, and service. She is the key technical interface between laboratory services and major clients. Ms. Hayes plans, develops, and establishes policies and objectives for developing a more technical marketing, sales, and service organization by providing the technical leadership, management, and vision necessary to ensure that the company has the proper operational controls, administrative procedures, and human resource management in place to meet customer need and quality objectives.

ACADEMIC AND PROFESSIONAL DEGREES:

M.S. Applied Chemistry, Colorado School of Mines, Golden, CO

B.S. Chemistry and Math, Luther College, Decorah, Iowa

Melanie Levesque**Quality Assurance Manager**

Ms. Levesque develops and supervises programs intended to ensure that the laboratory is producing data of known and acceptable quality. She oversees QC activities including various independent checks of laboratory systems, SOP generation, and corrective action procedures, as well as monitoring laboratory certification programs. Ms. Levesque has documented training in the approved methods and can verify that the laboratory is following the designated SOPs. In order to maintain independence from operations, Ms. Levesque does not engage in operations and production activities; she also reports directly to the Vice President. The QA Department conducts a yearly independent audit of the quality systems and methods criteria, and notifies laboratory directors of deficiencies via a written quarterly status report. In addition she has six years of environmental laboratory experience. Ms. Levesque has worked in a variety of positions including two years as an HPLC chemist, 2.5 years as a GC/MS chemist; she also has 3.5 years of laboratory supervisory experience.

ACADEMIC AND PROFESSIONAL DEGREES:

M.S., Analytical Chemistry, Rochester Institute of Technology, Rochester, NY

B.S., Chemistry, Rochester Institute of Technology, Rochester, NY

Nathan Shafer**Laboratory Department Head**

Mr. Nathan Shafer is the Department Manager for the Volatile Organic Compound (VOC) GC/MS analysis group. This department is responsible for all analyses via methods TO-14/15, VOST methods 0030 and 0031, TO-17, and all VOC pptv work in the area of vapor intrusion. Mr. Shafer is responsible for managing and overseeing all processes and resources involved in the daily operations of the VOC department. In addition, he provides technical support to client services, sales, and the department; he is also responsible for coaching and training team members, data review, scheduling, and conferencing. Mr. Shafer has been employed by Air Toxics since 1997. His experience comes from roles such as GC/MS chemist, team leader, and project development chemist.

ACADEMIC AND PROFESSIONAL DEGREES:

B.S. Chemistry and Psychology, Claremont McKenna College, Claremont, CA

Jeffrey Tecson**Support Services Team Leader**

Mr. Jeffrey Tecson is the Team Leader for the Support Services Team. This team is responsible for certifying and cleaning of Summa, Sileo, and Silonite Canisters. Other responsibilities include preparation of TO-17 tubes, and VOST/SMVOC tubes for Methods 0030 and 0031. Mr. Tecson has three years experience in doing bench work for Support Services. He is currently spending 25 percent of his time on the bench. Mr. Tecson has nine years management experience.

ACADEMIC AND PROFESSIONAL DEGREES:

A.S., Computer Technology, Heald College, Cordova, CA

Ausha Scott**Client Services and Login/Receiving Task Leader**

Ms. Ausha Scott is the Task Leader for the Client Services and Login/Receiving Departments. She is responsible for overseeing the daily activities of the Login/Receiving team, as well as providing technical support to the Client Services group. In addition, Ms. Scott has over four years of laboratory experience as a GC/MS chemist and one year as a Project Manager.

ACADEMIC AND PROFESSIONAL DEGREES:

B.S., Marine Biology, University of California, Santa Cruz, CA

Susan Alaniz**Client Services Representative/Project Manager
Task Leader**

Ms. Alaniz has worked in customer service for over ten years with approximately three years of project management experience. In her current position at Air Toxics, she serves as a liaison between the client and the laboratory, coordinating project setup and monitoring the progress of samples through analysis and reporting. Ms. Alaniz provides technical support to clients and maintains account information in the client services database. Ms. Alaniz keeps current, with ongoing in-house training, on air methods for sampling and analysis, as well as specific laboratory processes.

ACADEMIC AND PROFESSIONAL DEGREES:

B.S., Biological Sciences, University of California, Davis, CA

Noor Khan**Senior Scientist**

Mr. Khan is a Senior Scientist with seven years of experience analyzing air samples by GC/MS using EPA methods, including TO-14A, TO-15 and TO-17/VOST by modified EPA SW-846 methods. He is responsible for equipment operations and maintenance, data review, report generation, training of employees, sample scheduling, and preparation of standards. He has also worked in a supervisory role in the laboratory. Mr. Khan has experience with a wide variety of analytical techniques including MS, IR, and UV analysis to identify novel organic compounds.

ACADEMIC AND PROFESSIONAL DEGREES:

M.S., Analytical Chemistry, University of Texas, San Antonio, TX

B.S., Chemistry, University of Karachi, Karachi, Pakistan

Jeet Grewal**Lead Scientist VOST Analysis**

Mr. Grewal has been the lead scientist in VOST and TO-17 analysis for the last nine years at ATL, and he has extensive experience with VOST trial burn projects. His duties include routine VOST analysis, data writeup, work scheduling, and implementation of project specific QA/QC requirements. Mr. Grewal is actively involved with staff training and teaching VOST training classes. He is experienced with instrument maintenance, troubleshooting, solving analytical and technical problems, method development involving VOST, and TO-17 analyses. Prior to ATL, Mr. Grewal had eight years of experience as a GC and GC/MS chemist, including four years as a group leader in an environmental laboratory. Mr. Grewal holds a Bachelor's degree in Chemistry.

ACADEMIC AND PROFESSIONAL DEGREES:

B.S. Chemistry

Maisie Watson**Sample Custodian**

Mrs. Watson is responsible for all aspects of receiving and processing samples at ATL. She prepares samples in pressurized Summa canisters for analysis by the laboratory, and inputs sample information into the laboratory tracking database. Mrs. Watson ensures that the Chain-of-Custody procedures are followed and documents any discrepancies. Her prior experience involved screening environmental air samples on a GC/FID before the samples were analyzed by GC or GC/MS.

MUSTARD AGENT TRIAL BURN PLAN

FOR THE

LIQUID INCINERATORS

APPENDIX B

LIC SHAKEDOWN PLAN

REVISION 1

April 6, 2006

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LIC SHAKEDOWN PLAN

1.0 INTRODUCTION

The Tooele Chemical Agent Disposal Facility (TOCDF) was designed and built as a hazardous waste disposal facility for the U.S. Army. The TOCDF is designed to dispose of chemical Agents GB, VX, and mustard (H-series), drained munitions, contaminated refuse, bulk containers, liquid wastes, explosive, and propellant components, which are a part of the chemical agent stockpile at the Deseret Chemical Depot (DCD). The DCD is located 20 miles south of Tooele, Utah. EG&G Defense Materials, Inc. (EG&G) operates the TOCDF under contract to the U.S. Army through the Chemical Materials Agency (CMA).

The TOCDF operates two liquid incinerators (LIC1 and LIC2), which have been processing agent and spent decontamination solution (Decon) since August 1996 and July 1997, respectively, in separate Agent GB and VX campaigns. The remaining agent to be treated is the mustard agent series. The TOCDF is required to perform Agent Trial Burn (ATB) testing to demonstrate compliance with its RCRA permit, and a Comprehensive Performance Test (CPT) to demonstrate compliance with the Hazardous Waste Combustor (HWC) Maximum Achievable Control Technology (MACT) emission limits. Shakedown processing of mustard and Decon will commence when approvals for the ATB and CPT are received from the State of Utah, Department of Environmental Quality (DEQ), Division of Solid and Hazardous Waste (DSHW) and Division of Air Quality (DAQ). During shakedown, both incinerators will be thoroughly tested to verify that they perform in a safe, consistent, and predictable manner when processing mustard and Decon.

Each LIC includes a primary combustion chamber (PCC) followed by a secondary combustion chamber (SCC). Exhaust gas from the SCC is routed to the Pollution Abatement System (PAS), which includes a quench tower, high-energy venturi scrubber, low-energy packed bed scrubber, demister, and an induced draft (ID) fan.

The initial mustard operation at TOCDF will be the shakedown of the furnaces. For the LICs, the objectives of the shakedown period are as follows:

- Demonstrate that the LICs can safely and efficiently destroy mustard at the proposed permitted feed rates.
- Familiarize the operators and support personnel with the differences in operations between Agent GB/VX and mustard.
- Evaluate the LIC operating conditions required for permit compliance.
- Evaluate the impact on the SCC of simultaneously processing mustard and Decon.

2.0 PREPARATORY ACTIVITIES

The TOCDF will enter into a period of extensive decontamination of Agent VX once Agent VX operations are complete. The Automatic Continuous Air Monitoring System (ACAMS) and Depot Area Air Monitoring System (DAAMS) will be changed over to detect mustard during this maintenance period. For equipment and systems taken out of service for decontamination, particular care will be taken to assure that they are returned to operating conditions.

Several administrative activities will take place in parallel with the plant activities. The status of all operator, maintenance and shift risk management personnel training and certification will be audited, including signoff sheets for mustard-agent-specific and other procedure changes. Remaining entries in logs such as the Temporary Change Log, the Lock Out/Tag Out Log, and the log of open Maintenance Work Requests will be evaluated for impact on mustard processing. Finally, the plan for environmental and quality assurance audits and surveillances will be reviewed to assure proper coverage.

Formal briefings of key shift personnel will begin two days prior to the start of mustard processing as required by the TOCDF Critical Activities Manual (PRP-OP-044). Preparations for a new agent campaign are governed by Critical Activity # CA-01 Appendix 2, which provides for briefing of key management and shift personnel for two days before initial mustard processing. The briefings are repeated during the first week of the new campaign. These briefings ensure that the processing team is prepared prior to commencing the new campaign and then evaluate the adequacy of the preparations once mustard processing has begun.

Environmental personnel will conduct a status review of all TOCDF permits. They will confirm that all modifications have been incorporated into the appropriate permits, and will review laboratory and monitoring procedures to assure that the provisions of the Waste Analysis Plan (WAP) have been satisfied. Certain plant modifications require that an independent Professional Engineer certify the proper completion of construction through a Facility Construction Certification (FCC). The completion of any FCC activities will be confirmed.

Environmental will verify receipt of State approval of the ATB/CPT plans. They will verify that all permit conditions for processing mustard and Decon have been met. They will notify the plant manager when the plant has met the environmental requirements for startup. Environmental will notify the DSHW before mustard is processed in the plant.

3.0 GENERAL SHAKEDOWN ACTIVITIES

Baseline Operations will only process HD TCs that have mercury concentrations less than 1.0 milligram per kilogram (mg/kg) with the drained mustard going to the LICs and the TCs with their heels being processed in the MPF. This shakedown plan is for the processing of ton containers (TCs) containing mustard. Mustard from TCs will be introduced into each LIC in accordance with 40 CFR 264.344(c)(1) to bring the unit to a point of operational readiness for the LIC Mustard ATB. This phase will take 4 to 6 weeks per furnace and consist of up to 720 hours of agent processing. Extreme caution will be exercised as agent operations begin to ensure that all systems are functioning properly with the new agent feed.

The TOCDF will conduct pre-trial burn testing (pre-testing) at the proposed LIC Mustard ATB conditions during the 720-hour shakedown period to verify LIC and LIC PAS performance. Pre-testing will be conducted using the ACAMS and in some instances the DAAMS to verify no mustard is being emitted. TOCDF may request final modifications to the LIC Mustard ATB Plan based on the pre-test results. Changes to this plan will be coordinated with the DAQ and the DSHW.

Collection and analysis of samples during the shakedown period will follow the WAP. All agent samples collected will be analyzed for agent purity, agent impurities, Human Health Risk Assessment (HHRA) metals, and agent density. Results of the agent analyses will be reported as soon as they are available. Other process samples will be collected as directed by the WAP.

A dry run for the ATB will be performed once the LIC demonstrates the ability to process mustard and Decon at permitted rates for extended periods. The test will be performed on at least one of the LICs using the DAAMS to monitor for the Principal Organic Hazardous Constituent (POHC) as proposed in the ATB. The dry run will consist of one run at proposed test conditions, with objectives as follows:

- Operate the LIC at full ATB conditions for a sustained period of time.
- Demonstrate performance capabilities of the complete system and its individual components.
- Finalize preliminary operating conditions for the ATB.
- Confirm that the process data collection can meet the needs for the ATB. Verify the DAAMS collection and analysis will produce the data needed for the ATB. Data collection problems will be identified and corrected before the ATB.

The dry run results will be evaluated and the conditions for the actual ATB will be finalized.

4.0 LIC SHAKEDOWN ACTIVITIES

The following orderly shakedown steps will be taken after an Agent Collection System (ACS) tank is filled with mustard from TC processing. Transition between steps will be at the discretion of the EG&G Plant Shift Manager.

4.1 Initial Ramping of Mustard Agent Feed

For LIC1 and LIC2 the following steps will be used to initiate feed to the incinerators.

1. With other furnaces idling, start feeding mustard from an ACS tank to the LIC PCC and ramp up to 650 pounds/hour (lb/hr). Meanwhile, for the SCC process water will be fed at the normal rate.
 - (a) Collect the first special agent sample from the ACS tank once feed is steady at 650 lb/hr.
 - (b) While feeding agent, monitor agent readings throughout the Munitions Demilitarization Building (MDB).
 - (c) Sustain agent feed at 650 lb/hr for at least two hours. Then ramp agent feed down to 0 lb/hr.
2. Once feed has been secured, proceed with the following:
 - (a) Evaluate agent concentrations throughout the facility.
 - (b) Verify that Process Data Acquisition and Recording System (PDARS) has properly recorded the agent feed to the LIC. Verify that the agent totalizer reading is consistent with the change in the ACS tank level.
 - (c) Collect and analyze a LIC PAS brine sample for mustard.
 - (d) Collect and analyze a stack condensate sample for mustard.
3. Initiate mustard feed and ramp to 1,275 lb/hour. If Decon is available, initiate Decon feed in the SCC and monitor the processing of mustard and Decon concurrently.
4. Secure mustard and Decon feed (if initiated) once their respective tanks are empty.

4.2 Sustained Agent Feed Operations

For LIC1 and LIC2 the following steps will be used to initiate feed to the incinerators.

1. Refill an ACS tank and switch Spent Decontamination System (SDS) tanks. Then start mustard feed and ramp to 1,275 lb/hr. Ramp the Decon feed to 2,100 lb/hr.
2. Once all of the above operations have been successfully completed, process mustard and Decon through the LIC at up to permitted rates. LIC processing will continue to support MPF operations up to 720 hours of LIC processing have been completed.
3. When visual observation determines that slag is in the pit, the LIC Slag Removal System will be tested.

4.3 Collection of WAP Mustard Agent Samples

1. Drain available TCs until the ACS tank is full.
2. Secure munitions draining once the ACS tank is full. No munitions should be processed until the sample has been collected.
3. Collection and analysis of samples during the shakedown period will follow the WAP.
4. Start mustard feed to a LIC and ramp to 1,275 lb/hour. When steady at 1,275 lb/hr, collect an agent sample from the ACS tank in accordance with laboratory procedures.

5.0 POST MUSTARD AGENT TRIAL BURN ACTIVITIES

Following the ATB, feed rates to LIC1 and LIC2 will be restricted to ensure that emissions meet the RCRA and HWC MACT emission limits. The restricted feed limits will ensure that the emissions are below the HWC MACT emission limits and will allow continued operation until the final report has been submitted. The interim period between completion of the ATB and submittal of the ATB report could be several months. Therefore, mustard processing will continue at 50 percent of the feed rates achieved in the ATB while operating within the parameters demonstrated in the ATB. Preliminary data will be submitted to DSHW within five weeks of the ATB completion. The Executive Secretary will review the preliminary data and approve increasing the agent and Decon feed rates to 75 percent of the ATB feed rates. The ATB Report will be submitted within 90 days of completion of the ATB. The agent and Decon feed rates will be increased to 100 percent of the ATB feed rates when the ATB Report's Executive Summary has been reviewed by the State of Utah, Department of Environmental Quality, Executive Secretary and the Notice of Compliance is submitted to the DAQ.

**TOOELE CHEMICAL AGENT DISPOSAL
FACILITY
(TOCDF)**

**MUSTARD AGENT TRIAL BURN PLAN
FOR THE
LIQUID INCINERATORS**

APPENDIX C

**MASS AND ENERGY BALANCES FOR LIC MUSTARD ATB AND
EXHAUST GAS RESIDENCE TIME CALCULATIONS**

REVISION 1

April 6, 2006

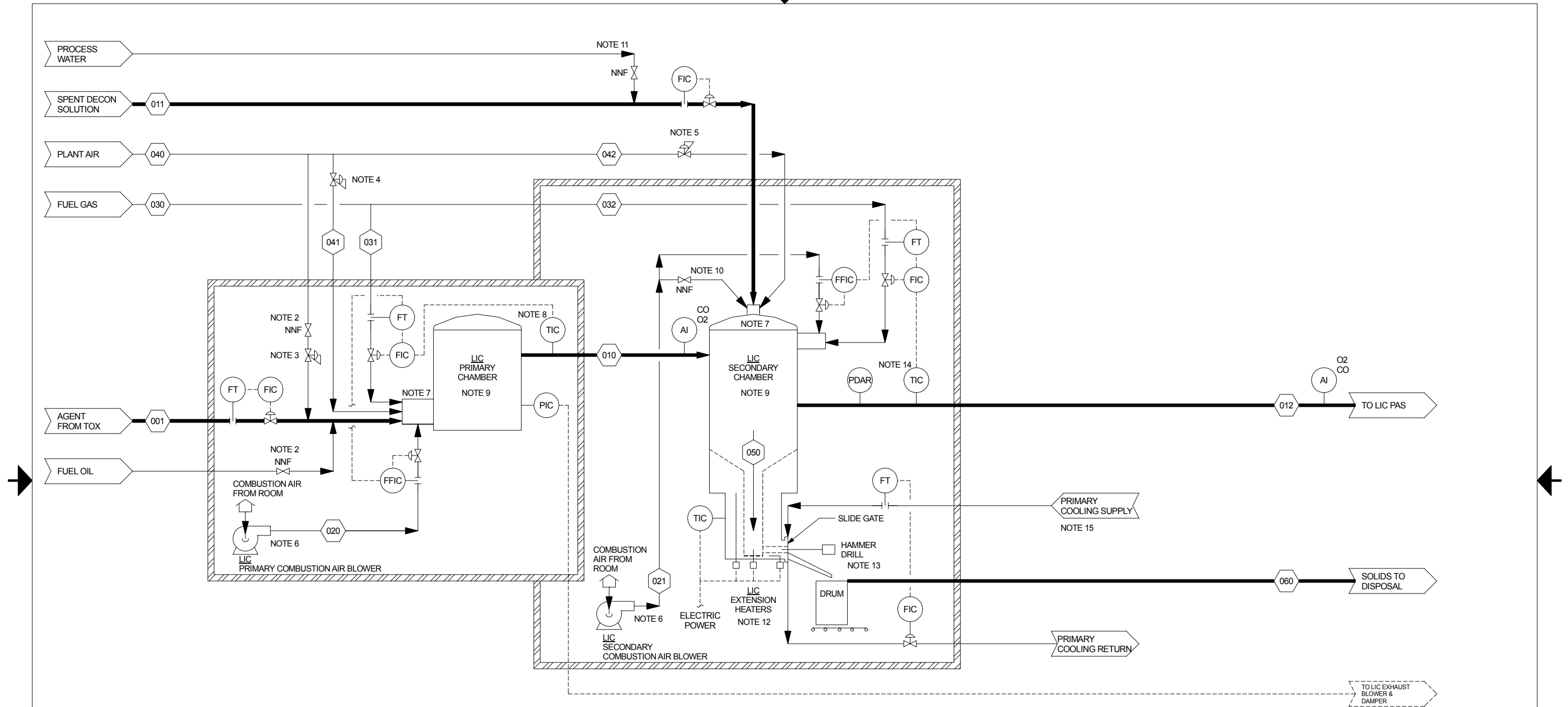
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Figure C-1
LIC Incinerator Process Flow Diagram



NOTES

1. STREAM TABLES WITH MASS & ENERGY BALANCE DETAILS ARE ON SHEET 2.
2. PLANT AIR AND DIESEL FUEL ARE USED TO PURGE AGENT FROM AGENT FEED LINE.
3. PCV SET PRESSURE IS 15 PSIG.
4. PCV SET AT 72 PSIG FOR THE TOP TIER AND 45 PSIG FOR THE MIDDLE TIER.
5. PCV SET AT 55 PSIG.
6. MAXIMUM ROOM TEMPERATURE IS 125 DEG F. COMBUSTION AIR TEMPERATURE IS INCREASED BY 20 DEG F AT THE OUTLET OF THE COMBUSTION AIR BLOWER.
7. LIQUID INJECTION THROUGH ATOMIZER TO PROVIDE A MEAN DROPLET SIZE LESS THAN 50 MICRONS AND MAXIMUM DROPLET SIZE NOT EXCEEDING 100 MICRONS.
8. TIC SETS FUEL GAS RATE AND FUEL GAS FLOW RATE PROVIDES SET POINT FOR COMBUSTION AIR FFI UNTIL PRIMARY EXHAUST IS AT OPERATING TEMPERATURE, THEN AIR FLOW IS SET AT CONSTANT RATE.
9. MINIMUM LIC GAS RETENTION TIME IS 2.0 SECONDS (INCLUDES CREDIT FOR RETENTION TIME IN DUCT DOWNSTREAM FROM SECONDARY).
10. BYPASS AIR IS USED DURING EXTENDED IDLE ONLY.
11. PROCESS WATER USED WHEN SPENT DECON SOLUTION IS NOT AVAILABLE.
12. ZONE 1 HAS NINE HEATERS, ZONE 2 HAS SIX HEATERS, AND ZONE 3 HAS ONE HEATER.
13. HAMMER DRILL UTILIZED TO LOOSEN SOLIDIFIED SLAG.
14. TIC SETS FUEL GAS FLOW RATE.
15. PRIMARY COOLING MEDIUM FOR COOLING SLIDE GATE.



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LIQUID INCINERATOR SYSTEM (LIC)
PROCESS FLOW DIAGRAM

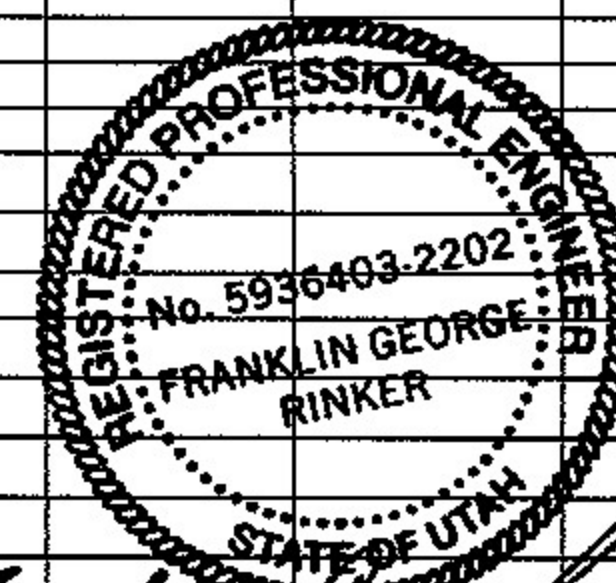
REV.	REVIEWED	APPROVED	DATE	SIZE	DWG. NO.	REV.
				B	LIC - PFD - 001	
DRAWN BY: MEV / ELR				SCALE	NONE	SHEET 1 OF
00/00/00						



Table C-1. Mustard ATB Maximum Feed Mass and Energy Balances

SITE: Tooele Army Depot, Tooele, Utah
 RUN: LIC
 AGENT: Metals Trial Burn
 CASE: HD + Spiking Agent A & B
 DATE: 7/27/2005

STREAM NUMBER		1	10	11	12	20	21	30	31	32	40	41	42	50
LINE DESCRIPTION		PRIMARY FEED (AGENT)	PRIMARY EXHAUST GAS	SECONDARY FEED SDS	SECONDARY EXHAUST GAS	PRIMARY COMB. AIR + LEAKAGE AIR	SECONDARY COMB. AIR	TOTAL FUEL GAS	PRIMARY FUEL GAS	SECONDARY FUEL GAS	TOTAL PLANT AIR	AGENT ATOMIZING AIR	SECONDARY ATOMIZING AIR	SECONDARY SLAG
TEMPERATURE	DEG. F	77.0	2,700	77.0	2,050	125.0	125.0	77.0	77.0	77.0	110.0	110.0	110.0	2,050
PRESSURE	PSIA	12.3	12.2	12.3	12.2	13.8	13.8	27.3	27.3	27.3	13.8	13.8	13.8	14.2
DENSITY	LBm/FT ³	79.2	0.011	79.3	0.013	0.063	0.063	0.078	0.078	0.078	0.065	0.065	0.065	
LIQUID FLOW	GPM	2.04		3.15										
GAS FLOW	ACFM		21,251		26,498	3,095	895.0	54.6	10.3	44.2	308.1	153.5	154.6	
GAS FLOW	DSCFM		2,704		3,502	2,559	740.1	98.2	18.6	79.6	261.5	130.3	131.2	
FUEL (NAT. GAS)	LBm/HR							255.4	48.3	207.0				
AGENT	LBm/HR	1,288												
MUNITION METAL	LBm/HR													
OTHER METAL	LBm/HR		2.63		2.63									
ASH	LBm/HR		0.00		0.00									
N ₂	LBm/HR		9,461		12,528	9,001	2,603				919.7	458.1	461.6	
O ₂	LBm/HR		963.3		1,059	2,719	786.3				277.8	138.4	139.4	
H ₂ O	LBm/HR		630.9	2,000	3,107	68.0	19.7				6.95	3.46	3.49	
CO ₂	LBm/HR		1,582		2,166									
CO	LBm/HR				1.08									
NO ₂	LBm/HR		0.00		0.034									
NO	LBm/HR				5.86									
SO ₂	LBm/HR		507.7		507.7									
H ₂	LBm/HR													
HCl	LBm/HR		577.9		582.8									
PO	LBm/HR		0.00		0.00									
NaOH	LBm/HR		0.00		0.00									
NaCl	LBm/HR		0.00		0.00									
NaOCl	LBm/HR													
Na ₂ HPO ₄	LBm/HR													
Na ₂ SO ₃	LBm/HR													
NaF	LBm/HR													
Na ₃ PO ₄	LBm/HR													
H ₂ SO ₄	LBm/HR													
H ₃ PO ₄	LBm/HR													
NaHCO ₃	LBm/HR													
NaNO ₃	LBm/HR													
Na ₂ CO ₃	LBm/HR													
METAL Cl	LBm/HR													
TOTAL	LBm/HR	1,288	13,725	2,000	19,960	11,788	3,409	255.4	48.3	207.0	1,205	800.0	604.5	0.00
TOTAL	LBMOLE/HR		462.6	111.0	726.2	408.5	118.1	15.6	2.95	12.6	41.7	20.8	20.9	
AVG MW		159.1	29.7	18.0	27.5	28.9	28.9	16.4	16.4	16.4	28.9	28.9	28.9	
ENTHALPY	BTU/LBm		775.4		756.1	17.0	58.9	20,777	20,777	20,777	17.4	17.4	17.4	



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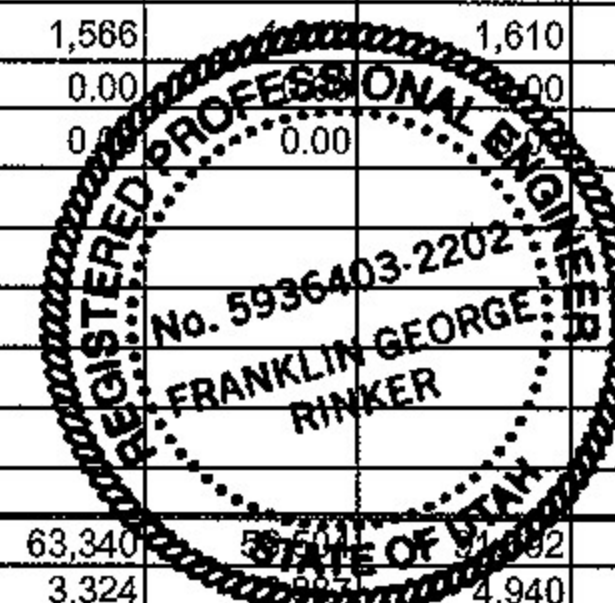
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Table C-1. Mustard ATB Maximum Feed Mass and Energy Balances (continued)

SITE: TOOELE CHEMICAL DEPOT, TOOELE, UTAH
 RUN: LIC PAS
 AGENT: Metals Trial Burn
 CASE: HD + Spiking Agent A & B
 DATE: 7/27/2005

STREAM NUMBER		012	200	210	211	212	213	214	220	221	222	223	224	225	226	227
LINE DESCRIPTION		QUENCH INLET GAS	QUENCH OVERHEAD GAS	VENTURI OUTLET GAS	VENTURI OUTLET LIQUID	SCRUBBER OVERHEAD GAS	MIST ELIM. OUTLET GAS	PAS OUTLET GAS TO STACK	QUENCH LIQUID OUTLET	SCRUBBER TRAY OVERFLO W	SUMP OUTLET BRINE	QUENCH/ VENTURI FEED BRINE	RECYCLE BRINE TO VENTURI	RECYCLE BRINE TO QUENCH	TOTAL QUENCH LIQUID	PAS BLEED BRINE
TEMPERATURE	DEG. F	1,949	165.6	166.3	166.3	165.3	165.3	204.3	148.6	168.1	156.4	156.4	147.6	156.4	125.2	156.4
PRESSURE	PSIA	11.9	11.8	10.3	10.3	10.1	10.0	14.3	11.8	10.1	85.0	85.0	85.0	85.0	85.0	85.0
DENSITY	LBm/FT ³	0.013	0.041	0.036	65.7	0.035	0.035	0.047	63.7	68.4	64.7	64.7	64.7	64.7	63.7	64.7
LIQUID FLOW	GPM				121.9				163.4	4.75	290.0	214.9	120.0	109.0	179.4	75.0
GAS FLOW	ACFM	26,288	11,305	12,628		12,639	12,765	9,484								
GAS FLOW	DSCFM	3,502	3,437	3,351		3,327	3,327	3,327								
FUEL (NAT. GAS)	LBm/HR															
AGENT	LBm/HR															
MUNITION METAL	LBm/HR															
OTHER METAL	LBm/HR															
ASH	LBm/HR															
N ₂	LBm/HR	12,528	12,528	12,528		12,528	12,528	12,528								
O ₂	LBm/HR	1,059	1,034	970.7		934.5	934.5	934.5								
H ₂ O	LBm/HR	3,107	11,703	11,386	58,839	11,098	11,098	11,098	79,652	2,259	140,751	104,327	58,313	52,887	88,075	36,424
CO ₂	LBm/HR	2,166	2,166	2,166		2,166	2,166	2,166								
CO	LBm/HR	1.08	1.08	1.08		1.08	1.08	1.08								
NO ₂	LBm/HR	0.034	0.034	0.034		0.034	0.034	0.034								
NO	LBm/HR	5.86	5.86	5.86		5.86	5.86	5.86								
SO ₂	LBm/HR	507.7	406.2	152.3	0.00	7.62	7.62	7.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H ₂	LBm/HR															
HCl	LBm/HR	582.8	291.4	11.7	0.00	0.350	0.350	0.350	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	LBm/HR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PO	LBm/HR	0.00	0.00	0.00		0.00	0.00	0.00								
NaOH	LBm/HR	0.00			1,518				204.7	9.89	1,733	1,284	2,142	651.2	651.2	448.5
NaCl	LBm/HR	0.00			1,767				1,823	18.1	3,607	2,674	1,318	1,355	1,355	933.5
NaOCl	LBm/HR															
Na ₂ HPO ₄	LBm/HR															
Na ₂ SO ₄	LBm/HR				2,129				1,835	320.8	4,285	3,176	1,566		1,610	1,109
NaF	LBm/HR				0.00				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na ₃ PO ₄	LBm/HR				0.00				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H ₂ SO ₄	LBm/HR	0.00														
H ₃ PO ₄	LBm/HR															
NaHCO ₃	LBm/HR															
NaNO ₃	LBm/HR															
Na ₂ CO ₃	LBm/HR															
Metals	LBm/HR	2.63	2.63	2.63		2.63	2.63	2.63								
TOTAL	LBm/HR	19,960	28,138	27,224	64,253	26,743	26,743	26,743	83,514	2,608	150,376	111,461	63,340	55,000	149,902	38,915
TOTAL	LBMOL/HR	726.1	1,193	1,162	3,349	1,142	1,142	1,142	4,471	128.2	7,948	5,891	3,324	3,324	4,940	2,057
AVG MW		27.5	23.6	23.4	19.2	23.4	23.4	23.4	18.7	20.3	18.9	18.9	19.1	18.9	18.6	18.9
ENTHALPY	BTU/LBm	722.8	469.3	472.1	83.1	468.3	468.3	481.1	69.2	85.4	75.4	75.4	85.5	75.4	46.5	75.4

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 August 21, 2005

Table C-1. Mustard ATB Maximum Feed Mass and Energy Balances (continued)

SITE: TOOELE CHEMICAL DEPOT, TOOELE, UTAH
 RUN: LIC
 AGENT: Metals Trial Burn
 CASE: HD + Spiking Agent A & B
 DATE: 7/27/2005

STREAM NUMBER		228	229	240	241	242	250	251	252
LINE DESCRIPTION		RECIRC. BRINE	SCRUBBER LIQUID FEED	TOTAL CAUSTIC	VENTURI INLET CAUSTIC	SCRUBBER CAUSTIC	TOTAL WATER	QUENCH MAKE-UP WATER	SCRUBBER MAKE-UP WATER
TEMPERATURE	DEG. F	168.1	165.4	77.0	77.0	77.0	77.0	77.0	77.0
PRESSURE	PSIA	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
DENSITY	LBm/FT ³	68.4	68.4	74.7	74.7	74.7	62.3	62.3	62.3
LIQUID FLOW	GPM	500.5	504.4	15.9	14.0	1.88	72.5	70.5	2.00
GAS FLOW	ACFM								
GAS FLOW	DSCFM								
FUEL (NAT. GAS)	LBm/HR								
AGENT	LBm/HR								
MUNITION METAL	LBm/HR								
OTHER METAL	LBm/HR								
ASH	LBm/HR								
N ₂	LBm/HR								
O ₂	LBm/HR								
H ₂ O	LBm/HR	238,000	239,925	7,798	6,874	924.7	36,188	35,188	1,000
CO ₂	LBm/HR								
CO	LBm/HR								
NO ₂	LBm/HR								
NO	LBm/HR								
SO ₂	LBm/HR	0.00	0.00						
H ₂	LBm/HR								
HCl	LBm/HR	0.00	0.00						
HF	LBm/HR	0.00	0.00						
PO	LBm/HR								
NaOH	LBm/HR	1,042	1,245	1,712	1,509	203.0			
NaCl	LBm/HR	1,909	1,909				0.00	0.00	0.00
NaOCl	LBm/HR								
Na ₂ HPO ₄	LBm/HR								
Na ₂ SO ₄	LBm/HR	33,793	33,793						
NaF	LBm/HR	0.00	0.00						
Na ₃ PO ₄	LBm/HR	0.00	0.00						
H ₂ SO ₄	LBm/HR								
H ₃ PO ₄	LBm/HR								
NaHCO ₃	LBm/HR								
NaNO ₃	LBm/HR								
Na ₂ CO ₃	LBm/HR								
Metals	LBm/HR								
TOTAL	LBm/HR	274,744	276,872	9,510	8,383	1,128	36,188	35,188	1,000
TOTAL	LBMOLE/HR	13,508	13,620	475.7	419.3	56.4	2,009	1,953	55.5
AVG MW		20.3	20.3	20.0	20.0	20.0	18.0	18.0	18.0
ENTHALPY	BTU/LBm	85.4	84.8	14.2	0.00	14.2	0.00	0.00	0.00

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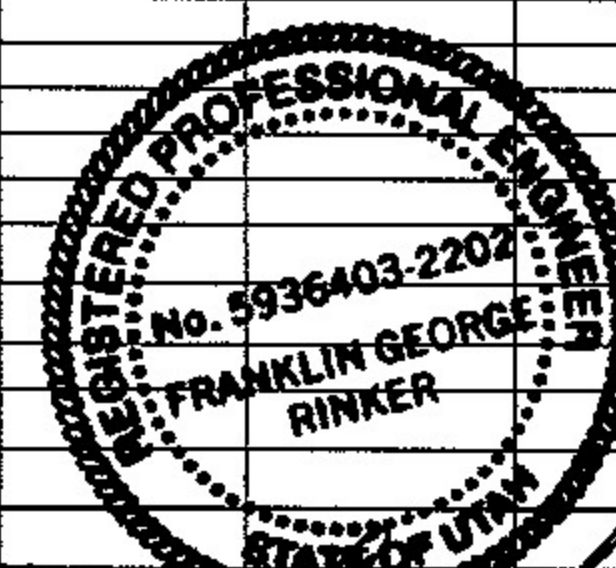


Franklin George Rinker
 August 21, 2005

Table C-2. Mustard HD Agent Maximum Feed Mass and Energy Balances

SITE: Tooele Army Depot, Tooele, Utah
 RUN: LIC
 AGENT: HD
 CASE: Max Feed
 DATE: 7/27/2005

STREAM NUMBER		1	10	11	12	20	21	30	31	32	40	41	42	50
LINE DESCRIPTION		PRIMARY FEED (AGENT)	PRIMARY EXHAUST GAS	SECONDARY FEED SDS	SECONDARY EXHAUST GAS	PRIMARY COMB. AIR + LEAKAGE AIR	SECONDARY COMB. AIR	TOTAL FUEL GAS	PRIMARY FUEL GAS	SECONDARY FUEL GAS	TOTAL PLANT AIR	AGENT ATOMIZING AIR	SECONDARY ATOMIZING AIR	SECONDARY SLAG
TEMPERATURE	DEG. F	77.0	2,700	77.0	2,050	125.0	125.0	77.0	77.0	77.0	110.0	110.0	110.0	2,050
PRESSURE	PSIA	12.3	12.2	12.3	12.2	13.8	13.8	27.3	27.3	27.3	13.8	13.8	13.8	14.2
DENSITY	LBm/FT ³	79.2	0.011	79.3	0.013	0.063	0.063	0.078	0.078	0.078	0.065	0.065	0.065	
LIQUID FLOW	GPM	2.00		3.15										
GAS FLOW	ACFM		21,240		26,489	3,095	895.0	56.0	11.7	44.3	308.1	153.5	154.6	
GAS FLOW	DSCFM		2,705		3,503	2,559	740.1	100.7	21.0	79.6	261.5	130.3	131.2	
FUEL (NAT. GAS)	LBm/HR							261.9	54.7	207.2				
AGENT	LBm/HR	1,275												
MUNITION METAL	LBm/HR													
OTHER METAL	LBm/HR		0.00		0.00									
ASH	LBm/HR		0.00		0.00									
N ₂	LBm/HR		9,461		12,528	9,001	2,603				919.7	458.1	461.6	
O ₂	LBm/HR		980.0		1,075	2,719	786.3				277.8	138.4	139.4	
H ₂ O	LBm/HR		623.0	2,000	3,100	68.0	19.7				6.95	3.46	3.49	
CO ₂	LBm/HR		1,556		2,141									
CO	LBm/HR				1.08									
NO ₂	LBm/HR		0.00		0.034									
NO	LBm/HR				5.90									
SO ₂	LBm/HR		513.5		513.5									
H ₂	LBm/HR													
HCl	LBm/HR		584.5		589.3									
PO	LBm/HR		0.00		0.00									
NaOH	LBm/HR		0.00		0.00									
NaCl	LBm/HR		0.00		0.00									
NaOCl	LBm/HR													
Na ₂ HPO ₄	LBm/HR													
Na ₂ SO ₃	LBm/HR													
NaF	LBm/HR													
Na ₃ PO ₄	LBm/HR													
H ₂ SO ₄	LBm/HR													
H ₃ PO ₄	LBm/HR													
NaHCO ₃	LBm/HR													
NaNO ₃	LBm/HR													
Na ₂ CO ₃	LBm/HR													
METAL Cl	LBm/HR													
TOTAL	LBm/HR	1,275	13,718	2,000	19,953	11,788	3,409	261.9	54.7	207.2	1,205	600.0	604.5	0.00
TOTAL	LBMOLE/HR		462.3	111.0	725.9	408.5	118.1	16.0	3.33	12.6	41.7	20.8	20.9	
AVG MW		159.1	29.7	18.0	27.5	28.9	28.9	16.4	16.4	16.4	28.9	28.9	28.9	
ENTHALPY	BTU/LBm		774.2		755.5	17.0	58.9	20,777	20,777	20,777	17.4	17.4	17.4	



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Table C-2. Mustard HD Agent Maximum Feed Mass and Energy Balances (continued)

SITE: TOOELE CHEMICAL DEPOT, TOOELE, UTAH
 RUN: LIC PAS
 AGENT: HD
 CASE: Max Feed
 DATE: 7/27/2005

STREAM NUMBER		012	200	210	211	212	213	214	220	221	222	223	224	225	226	227
LINE DESCRIPTION		QUENCH INLET GAS	QUENCH OVERHEAD GAS	VENTURI OUTLET GAS	VENTURI OUTLET LIQUID	SCRUBBER OVERHEAD GAS	MIST ELIM. OUTLET GAS	PAS OUTLET GAS TO STACK	QUENCH LIQUID OUTLET	SCRUBBER TRAY OVERFLO W	SUMP OUTLET BRINE	QUENCH/ VENTURI FEED BRINE	RECYCLE BRINE TO VENTURI	RECYCLE BRINE TO QUENCH	TOTAL QUENCH LIQUID	PAS BLEED BRINE
TEMPERATURE	DEG. F	1,949	165.5	166.3	166.3	165.3	165.3	204.3	148.5	168.1	156.4	156.4	147.4	156.4	125.2	156.4
PRESSURE	PSIA	11.9	11.8	10.3	10.3	10.1	10.0	14.3	11.8	10.1	85.0	85.0	85.0	85.0	85.0	85.0
DENSITY	LBm/FT ³	0.013	0.041	0.036	65.8	0.035	0.035	0.047	63.7	68.5	64.7	64.7	64.7	64.7	63.7	64.7
LIQUID FLOW	GPM				122.0				163.5	4.78	290.2	214.9	120.1	108.9	179.4	75.3
GAS FLOW	ACFM	26,280	11,301	12,622		12,632	12,759	9,479								
GAS FLOW	DSCFM	3,503	3,437	3,350		3,326	3,326	3,326								
FUEL (NAT. GAS)	LBm/HR															
AGENT	LBm/HR															
MUNITION METAL	LBm/HR															
OTHER METAL	LBm/HR															
ASH	LBm/HR															
N ₂	LBm/HR	12,528	12,528	12,528		12,528	12,528	12,528								
O ₂	LBm/HR	1,075	1,050	985.5		948.9	948.9	948.9								
H ₂ O	LBm/HR	3,100	11,694	11,379	58,905	11,089	11,089	11,089	79,668	2,272	140,845	104,295	58,378	52,877	88,088	36,549
CO ₂	LBm/HR	2,141	2,141	2,141		2,141	2,141	2,141								
CO	LBm/HR	1.08	1.08	1.08		1.08	1.08	1.08								
NO ₂	LBm/HR	0.034	0.034	0.034		0.034	0.034	0.034								
NO	LBm/HR	5.90	5.90	5.90		5.90	5.90	5.90								
SO ₂	LBm/HR	513.5	410.8	154.0	0.00	7.70	7.70	7.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H ₂	LBm/HR															
HCl	LBm/HR	589.3	294.7	11.8	0.00	0.354	0.354	0.354	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	LBm/HR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PO	LBm/HR	0.00	0.00	0.00		0.00	0.00	0.00								
NaOH	LBm/HR	0.00			1,537				207.2	10.0	1,755	1,299	2,168	658.7	658.7	455.3
NaCl	LBm/HR	0.00			1,781				1,838	18.3	3,638	2,694	1,328	1,366	1,366	944.0
NaOCl	LBm/HR															
Na ₂ HPO ₄	LBm/HR															
Na ₂ SO ₄	LBm/HR				2,147				1,850	324.5	4,321	3,200	1,578		1,622	1,121
NaF	LBm/HR				0.00				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na ₃ PO ₄	LBm/HR				0.00				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H ₂ SO ₄	LBm/HR	0.00														
H ₃ PO ₄	LBm/HR															
NaHCO ₃	LBm/HR															
NaNO ₃	LBm/HR															
Na ₂ CO ₃	LBm/HR															
Metals	LBm/HR	0.00	0.00	0.00		0.00	0.00	0.00								
TOTAL	LBm/HR	19,953	28,125	27,206	64,371	26,722	26,722	26,722	83,563	2,625	150,558	111,488	63,432	1,734	1,734	39,070
TOTAL	LBMOLE/HR	725.9	1,193	1,161	3,354	1,141	1,141	1,141	4,472	129.0	7,955	5,890	3,329	4,941	4,941	2,064
AVG MW		27.5	23.6	23.4	19.2	23.4	23.4	23.4	18.7	20.4	18.9	18.9	19.1	18.9	18.6	18.9
ENTHALPY	BTU/LBm	722.2	469.1	472.1	83.1	468.3	468.3	481.1	69.1	85.4	75.4	75.4	65.3	75.4	46.4	75.4

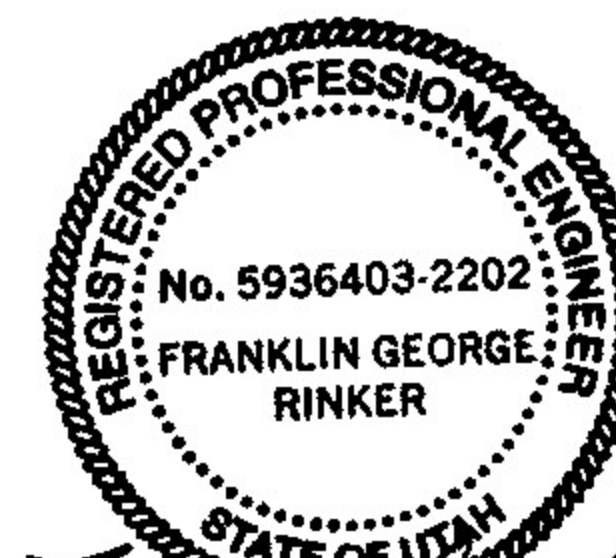
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Table C-2. Mustard HD Agent Maximum Feed Mass and Energy Balances (continued)

SITE: TOOELE CHEMICAL DEPOT, TOOELE, UTAH
 RUN: LIC PAS
 AGENT: HD
 CASE: Max Feed
 DATE: 7/27/2005

STREAM NUMBER		228	229	240	241	242	250	251	252
LINE DESCRIPTION		RECIRC. BRINE	SCRUBBER LIQUID FEED	TOTAL CAUSTIC	VENTURI INLET CAUSTIC	SCRUBBER CAUSTIC	TOTAL WATER	QUENCH MAKE-UP WATER	SCRUBBER MAKE-UP WATER
TEMPERATURE	DEG. F	168.1	165.4	77.0	77.0	77.0	77.0	77.0	77.0
PRESSURE	PSIA	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
DENSITY	LBm/FT ³	68.5	68.5	74.7	74.7	74.7	62.3	62.3	62.3
LIQUID FLOW	GPM	500.6	504.5	16.1	14.2	1.90	72.5	70.5	2.00
GAS FLOW	ACFM								
GAS FLOW	DSCFM								
FUEL (NAT. GAS)	LBm/HR								
AGENT	LBm/HR								
MUNITION METAL	LBm/HR								
OTHER METAL	LBm/HR								
ASH	LBm/HR								
N ₂	LBm/HR								
O ₂	LBm/HR								
H ₂ O	LBm/HR	238,000	239,935	7,895	6,959	935.2	36,211	35,211	1,000
CO ₂	LBm/HR								
CO	LBm/HR								
NO ₂	LBm/HR								
NO	LBm/HR								
SO ₂	LBm/HR	0.00	0.00						
H ₂	LBm/HR								
HCl	LBm/HR	0.00	0.00						
HF	LBm/HR	0.00	0.00						
PO	LBm/HR								
NaOH	LBm/HR	1,048	1,253	1,733	1,528	205.3			
NaCl	LBm/HR	1,920	1,920				0.00	0.00	0.00
NaOCl	LBm/HR								
Na ₂ HPO ₄	LBm/HR								
Na ₂ SO ₄	LBm/HR	33,990	33,990						
NaF	LBm/HR	0.00	0.00						
Na ₃ PO ₄	LBm/HR	0.00	0.00						
H ₂ SO ₄	LBm/HR								
H ₃ PO ₄	LBm/HR								
NaHCO ₃	LBm/HR								
NaNO ₃	LBm/HR								
Na ₂ CO ₃	LBm/HR								
Metals	LBm/HR								
TOTAL	LBm/HR	274,958	277,098	9,628	8,487	1,140	36,211	35,211	1,000
TOTAL	LBMOLE/HR	13,509	13,622	481.5	424.5	57.0	2,010	1,955	55.5
AVG MW		20.4	20.3	20.0	20.0	20.0	18.0	18.0	18.0
ENTHALPY	BTU/LBm	85.4	84.8	14.2	0.00	14.2	0.00	0.00	0.00

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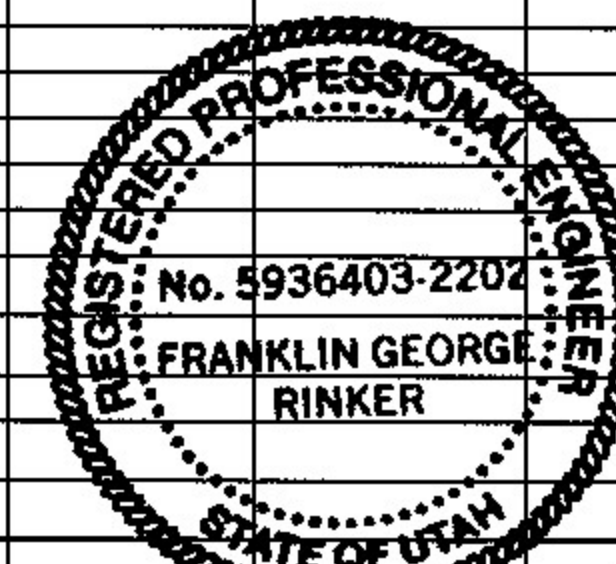


Franklin George Rinker
 August 21, 2005

Table C-3. Mustard HT Agent Maximum Feed Mass and Energy Balances

SITE: Tooele Army Depot, Tooele, Utah
 RUN: LIC
 AGENT: HT
 CASE: Max Feed
 DATE: 7/27/2005

STREAM NUMBER		1	10	11	12	20	21	30	31	32	40	41	42	50
LINE DESCRIPTION		PRIMARY FEED (AGENT)	PRIMARY EXHAUST GAS	SECONDARY FEED SDS	SECONDARY EXHAUST GAS	PRIMARY COMB. AIR + LEAKAGE AIR	SECONDARY COMB. AIR	TOTAL FUEL GAS	PRIMARY FUEL GAS	SECONDARY FUEL GAS	TOTAL PLANT AIR	AGENT ATOMIZING AIR	SECONDARY ATOMIZING AIR	SECONDARY SLAG
TEMPERATURE	DEG. F	77.0	2,700	77.0	2,050	125.0	125.0	77.0	77.0	77.0	110.0	110.0	110.0	2,050
PRESSURE	PSIA	12.3	12.2	12.3	12.2	13.8	13.8	27.3	27.3	27.3	13.8	13.8	13.8	14.2
DENSITY	LBm/FT ³	79.2	0.011	79.3	0.013	0.063	0.063	0.078	0.078	0.078	0.065	0.065	0.065	
LIQUID FLOW	GPM	1.91		3.15										
GAS FLOW	ACFM		21,205		26,460	3,095	895.0	56.1	11.9	44.2	308.1	153.5	154.6	
GAS FLOW	DSCFM		2,680		3,478	2,559	740.1	100.9	21.5	79.5	261.5	130.3	131.2	
FUEL (NAT. GAS)	LBm/HR							262.6	55.8	206.7				
AGENT	LBm/HR	1,217												
MUNITION METAL	LBm/HR													
OTHER METAL	LBm/HR		0.00		0.00									
ASH	LBm/HR		0.00		0.00									
N ₂	LBm/HR		9,461		12,528	9,001	2,603				919.7	458.1	461.6	
O ₂	LBm/HR		901.9		999.2	2,719	786.3				277.8	138.4	139.4	
H ₂ O	LBm/HR		682.1	2,000	3,158	68.0	19.7				6.95	3.46	3.49	
CO ₂	LBm/HR		1,622		2,205									
CO	LBm/HR				1.10									
NO ₂	LBm/HR		0.00		0.032									
NO	LBm/HR				5.69									
SO ₂	LBm/HR		536.1		536.1									
H ₂	LBm/HR													
HCl	LBm/HR		458.5		463.4									
PO	LBm/HR		0.00		0.00									
NaOH	LBm/HR		0.00		0.00									
NaCl	LBm/HR		0.00		0.00									
NaOCl	LBm/HR													
Na ₂ HPO ₄	LBm/HR													
Na ₂ SO ₃	LBm/HR													
NaF	LBm/HR													
Na ₃ PO ₄	LBm/HR													
H ₂ SO ₄	LBm/HR													
H ₃ PO ₄	LBm/HR													
NaHCO ₃	LBm/HR													
NaNO ₃	LBm/HR													
Na ₂ CO ₃	LBm/HR													
METAL Cl	LBm/HR													
TOTAL	LBm/HR	1,217	13,661	2,000	19,896	11,788	3,409	262.6	55.8	206.7	1,205	600.0	604.5	0.00
TOTAL	LBMOLE/HR		461.6	111.0	725.1	408.5	118.1	16.0	3.40	12.6	41.7	20.8	20.9	
AVG MW		193.5	29.6	18.0	27.4	28.9	28.9	16.4	16.4	16.4	28.9	28.9	28.9	
ENTHALPY	BTU/LBm		783.8		761.5	17.0	58.9	20,777	20,777	20,777	17.4	17.4	17.4	



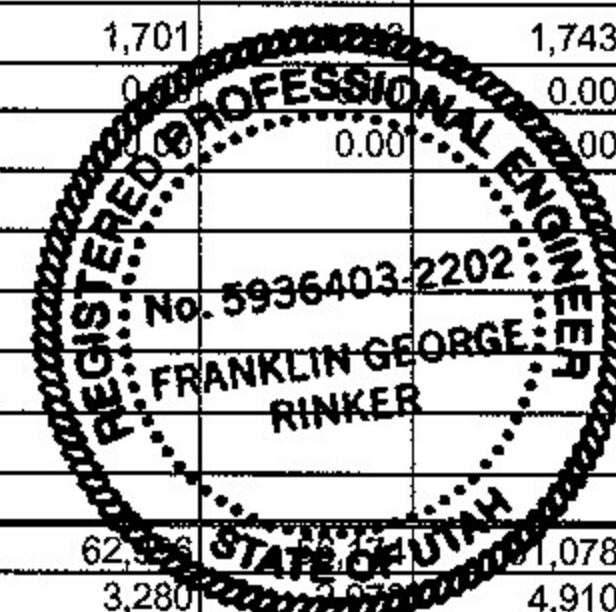
Franklin George Rinker
 August 21, 2005

Table C-3. Mustard HT Agent Maximum Feed Mass and Energy Balances (continued)

SITE: TOOELE CHEMICAL DEPOT, TOOELE, UTAH
 RUN: LIC PAS
 AGENT: HT
 CASE: Max Feed
 DATE: 7/27/2005

STREAM NUMBER		012	200	210	211	212	213	214	220	221	222	223	224	225	226	227
LINE DESCRIPTION		QUENCH INLET GAS	QUENCH OVERHEAD GAS	VENTURI OUTLET GAS	VENTURI OUTLET LIQUID	SCRUBBER OVERHEAD GAS	MIST ELIM. OUTLET GAS	PAS OUTLET GAS TO STACK	QUENCH LIQUID OUTLET	SCRUBBER TRAY OVERFLO W	SUMP OUTLET BRINE	QUENCH/ VENTURI FEED BRINE	RECYCLE BRINE TO VENTURI	RECYCLE BRINE TO QUENCH	TOTAL QUENCH LIQUID	PAS BLEED BRINE
TEMPERATURE	DEG. F	1,949	166.1	167.0	167.0	166.0	166.0	205.0	149.1	168.2	156.9	156.9	148.9	156.9	125.6	156.9
PRESSURE	PSIA	11.9	11.8	10.3	10.3	10.1	10.00	14.3	11.8	10.1	85.0	85.0	85.0	85.0	85.0	85.0
DENSITY	LBm/FT ³	0.013	0.041	0.036	65.5	0.035	0.035	0.047	63.6	68.6	64.5	64.5	64.5	64.5	63.6	64.5
LIQUID FLOW	GPM				120.3				162.3	4.85	287.4	214.4	118.6	108.5	178.4	72.9
GAS FLOW	ACFM	26,251	11,312	12,682		12,688	12,814	9,520								
GAS FLOW	DSCFM	3,478	3,422	3,343		3,319	3,319	3,319								
FUEL (NAT. GAS)	LBm/HR															
AGENT	LBm/HR															
MUNITION METAL	LBm/HR															
OTHER METAL	LBm/HR															
ASH	LBm/HR															
N ₂	LBm/HR	12,528	12,528	12,528		12,528	12,528	12,528								
O ₂	LBm/HR	999.2	972.4	905.5		867.3	867.3	867.3								
H ₂ O	LBm/HR	3,158	11,740	11,474	58,119	11,177	11,177	11,177	79,191	2,306	139,616	104,194	57,668	52,725	87,629	35,422
CO ₂	LBm/HR	2,205	2,205	2,205		2,205	2,205	2,205								
CO	LBm/HR	1.10	1.10	1.10		1.10	1.10	1.10								
NO ₂	LBm/HR	0.032	0.032	0.032		0.032	0.032	0.032								
NO	LBm/HR	5.69	5.69	5.69		5.69	5.69	5.69								
SO ₂	LBm/HR	536.1	428.9	160.8	0.00	8.04	8.04	8.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H ₂	LBm/HR															
HCl	LBm/HR	463.4	231.7	9.27	0.00	0.278	0.278	0.278	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HF	LBm/HR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PO	LBm/HR	0.00	0.00	0.00		0.00	0.00	0.00								
NaOH	LBm/HR	0.00			1,369				213.5	10.3	1,593	1,189	1,948	601.6	601.6	404.1
NaCl	LBm/HR	0.00			1,435				1,476	14.4	2,926	2,183	1,079	1,105	1,105	742.3
NaOCl	LBm/HR															
Na ₂ HPO ₄	LBm/HR															
Na ₂ SO ₄	LBm/HR				2,296				1,980	338.8	4,615	3,444	1,701		1,743	1,171
NaF	LBm/HR				0.00				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na ₃ PO ₄	LBm/HR				0.00				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H ₂ SO ₄	LBm/HR	0.00														
H ₃ PO ₄	LBm/HR															
NaHCO ₃	LBm/HR															
NaNO ₃	LBm/HR															
Na ₂ CO ₃	LBm/HR															
Metals	LBm/HR	0.00	0.00	0.00		0.00	0.00	0.00								
TOTAL	LBm/HR	19,896	28,112	27,289	63,219	26,792	26,792	26,792	82,861	2,669	148,749	111,011	62,996	51,078	1,078	37,739
TOTAL	LBMOLE/HR	725.1	1,193	1,165	3,301	1,145	1,145	1,145	4,440	130.9	7,872	5,875	3,280	4,910	1,997	1,997
AVG MW		27.4	23.6	23.4	19.2	23.4	23.4	23.4	18.7	20.4	18.9	18.9	19.0	18.9	18.5	18.9
ENTHALPY	BTU/LBm	728.1	471.3	474.7	84.2	470.9	470.9	483.7	69.9	85.5	76.3	76.3	67.0	76.3	47.0	76.3

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Franklin George Rinker
 August 21, 2005

Table C-3. Mustard HT Agent Maximum Feed Mass and Energy Balances (continued)

SITE: TOOELE CHEMICAL DEPOT, TOOELE, UTAH
 RUN: LIC
 AGENT: HT
 CASE: Max Feed
 DATE: 7/27/2005

STREAM NUMBER		228	229	240	241	242	250	251	252
LINE DESCRIPTION		RECIRC. BRINE	SCRUBBER LIQUID FEED	TOTAL CAUSTIC	VENTURI INLET CAUSTIC	SCRUBBER CAUSTIC	TOTAL WATER	QUENCH MAKE-UP WATER	SCRUBBER MAKE-UP WATER
TEMPERATURE	DEG. F	168.2	165.4	77.0	77.0	77.0	77.0	77.0	77.0
PRESSURE	PSIA	85.0	85.0	85.0	85.0	85.0	85.0	85.0	85.0
DENSITY	LBm/FT ³	68.6	68.6	74.7	74.7	74.7	62.3	62.3	62.3
LIQUID FLOW	GPM	500.8	504.8	14.6	12.6	1.96	71.9	69.9	2.00
GAS FLOW	ACFM								
GAS FLOW	DSCFM								
FUEL (NAT. GAS)	LBm/HR								
AGENT	LBm/HR								
MUNITION METAL	LBm/HR								
OTHER METAL	LBm/HR								
ASH	LBm/HR								
N ₂	LBm/HR								
O ₂	LBm/HR								
H ₂ O	LBm/HR	238,000	239,961	7,160	6,198	961.3	35,904	34,904	1,000
CO ₂	LBm/HR								
CO	LBm/HR								
NO ₂	LBm/HR								
NO	LBm/HR								
SO ₂	LBm/HR	0.00	0.00						
H ₂	LBm/HR								
HCl	LBm/HR	0.00	0.00						
HF	LBm/HR	0.00	0.00						
PO	LBm/HR								
NaOH	LBm/HR	1,068	1,279	1,572	1,361	211.0			
NaCl	LBm/HR	1,487	1,487				0.00	0.00	0.00
NaOCl	LBm/HR								
Na ₂ HPO ₄	LBm/HR								
Na ₂ SO ₄	LBm/HR	34,969	34,969						
NaF	LBm/HR	0.00	0.00						
Na ₃ PO ₄	LBm/HR	0.00	0.00						
H ₂ SO ₄	LBm/HR								
H ₃ PO ₄	LBm/HR								
NaHCO ₃	LBm/HR								
NaNO ₃	LBm/HR								
Na ₂ CO ₃	LBm/HR								
Metals	LBm/HR								
TOTAL	LBm/HR	275,524	277,697	8,731	7,559	1,172	35,904	34,904	1,000
TOTAL	LBMOLE/HR	13,509	13,623	436.7	378.1	58.6	1,993	1,937	55.5
AVG MW		20.4	20.4	20.0	20.0	20.0	18.0	18.0	18.0
ENTHALPY	BTU/LBm	85.5	84.9	14.2	0.00	14.2	0.00	0.00	0.00

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Franklin George Rinker
 August 21, 2005

TABLE C-4. LIC EXHAUST GAS RESIDENCE TIME CALCULATION for AGENT TRIAL BURN MAXIMUM FEED

Section Description	A	B	C $C=(B/2)^2 * 3.14159$	D $D= A * C$	E	F $F= D * 60 / E$
	Length ^a (ft)	Diameter ^a (ft)	X-Sectional Area (ft ²)	Section Volume (ft ³)	Gas Flow Rate ^b (ft ³ /min)	Residence Time (sec)
LIC Primary Combustion Chamber (PCC) ^c	8.16	4.34	14.82	120.87	21,251	0.34
Cross-Over Duct (Duct Joining PCC & SCC)	19.03	2.46	4.75	90.33	21,251	0.26
LIC Secondary Combustion Chamber (SCC) ^d	6.44	5.83	26.73	172.04	26,498	0.39
Exhaust Duct (from exit of SCC to Venturi approach)	58.40	3.18	7.93	462.94	26,498	1.05
Venturi Approach	2.33	2.64	5.47	12.77	26,498	0.03
Venturi Exit	5.54	2.64	5.47	30.33	26,498	0.07
Exhaust Duct (from Venturi exit to 13-TE-129 (13-TE-782))	14.00	3.18	7.94	111.19	26,498	0.25
Totals ⇒				1,000		2.38

a Dimensions are taken from LIC refractory installation drawings, which are available onsite for review.

b Exhaust gas flow rates from the Heat and Material Balance are found in Appendix C for the Maximum Operating Condition

c The length or height of the LIC PCC is measured from the centerline of the burner to the centerline of the exhaust duct.

d The length or height of the LIC SCC is measured from the centerline of the inlet duct to the centerline of the exhaust duct.

TABLE C-5. LIC EXHAUST GAS RESIDENCE TIME CALCULATION for AGENT HD MAXIMUM FEED

Section Description	A	B	C $C=(B/2)^2 * 3.14159$	D $D= A * C$	E	F $F= D * 60 / E$
	Length ^a (ft)	Diameter ^a (ft)	X-Sectional Area (ft ²)	Section Volume (ft ³)	Gas Flow Rate ^b (ft ³ /min)	Residence Time (sec)
LIC Primary Combustion Chamber (PCC) ^c	8.16	4.34	14.82	120.87	21,240	0.34
Cross-Over Duct (Duct Joining PCC & SCC)	19.03	2.46	4.75	90.33	21,240	0.26
LIC Secondary Combustion Chamber (SCC) ^d	6.44	5.83	26.73	172.04	26,489	0.39
Exhaust Duct (from exit of SCC to Venturi approach)	58.40	3.18	7.93	462.94	26,489	1.05
Venturi Approach	2.33	2.64	5.47	12.77	26,489	0.03
Venturi Exit	5.54	2.64	5.47	30.33	26,489	0.07
Exhaust Duct (from Venturi exit to 13-TE-129 (13-TE-782))	14.00	3.18	7.94	111.19	26,489	0.25
Totals ⇒				1,000		2.38

a Dimensions are taken from LIC refractory installation drawings, which are available onsite for review.

b Exhaust gas flow rates from the Heat and Material Balance are found in Appendix C for the Maximum Operating Condition

c The length or height of the LIC PCC is measured from the centerline of the burner to the centerline of the exhaust duct.

d The length or height of the LIC SCC is measured from the centerline of the inlet duct to the centerline of the exhaust duct.

TABLE C-6. LIC EXHAUST GAS RESIDENCE TIME CALCULATION for AGENT HT MAXIMUM FEED

Section Description	A	B	C $C=(B/2)^2 * 3.14159$	D $D= A * C$	E	F $F= D * 60 / E$
	Length ^a (ft)	Diameter ^a (ft)	X-Sectional Area (ft ²)	Section Volume (ft ³)	Gas Flow Rate ^b (ft ³ /min)	Residence Time (sec)
LIC Primary Combustion Chamber (PCC) ^c	8.16	4.34	14.82	120.87	21,205	0.34
Cross-Over Duct (Duct Joining PCC & SCC)	19.03	2.46	4.75	90.33	21,205	0.26
LIC Secondary Combustion Chamber (SCC) ^d	6.44	5.83	26.73	172.04	26,460	0.39
Exhaust Duct (from exit of SCC to Venturi approach)	58.40	3.18	7.93	462.94	26,460	1.05
Venturi Approach	2.33	2.64	5.47	12.77	26,460	0.03
Venturi Exit	5.54	2.64	5.47	30.33	26,460	0.07
Exhaust Duct (from Venturi exit to 13-TE-129 (13-TE-782))	14.00	3.18	7.94	111.19	26,460	0.25
Totals ⇒				1,000		2.39

a Dimensions are taken from LIC refractory installation drawings, which are available onsite for review.

b Exhaust gas flow rates from the Heat and Material Balance are found in Appendix C for the Maximum Operating Condition

c The length or height of the LIC PCC is measured from the centerline of the burner to the centerline of the exhaust duct.

d The length or height of the LIC SCC is measured from the centerline of the inlet duct to the centerline of the exhaust duct.

**TOOELE CHEMICAL AGENT DISPOSAL
FACILITY
(TOCDF)**

**MUSTARD AGENT TRIAL BURN PLAN
FOR THE
LIQUID INCINERATORS**

APPENDIX D

**AUTOMATIC WASTE FEED CUTOFF TABLES AND OPERATING
CONDITION TARGET VALUE TABLES FOR LIQUID
INCINERATORS 1 AND 2**

REVISION 1

April 6, 2006

LIST OF TABLES

Table D-1	Liquid Incinerator RCRA Automatic Waste Feed Cutoff	D-1
Table D-2	Liquid Incinerator MACT Automatic Waste Feed Cutoff.....	D-2

Table D-1
LIQUID INCINERATOR
RCRA AUTOMATIC WASTE FEED CUTOFF

Item Number	Tag Number LIC1/LIC2	Process Data Description ^a	Setpoint ^{bc}
1	13-FIC-127/731	Agent Feed Rate Greater Than or Equal to	≥ 1275 lb/hr Mustard Agent, one-hour rolling average
2	13-PAL-128/736	Agent Atomizing Air Pressure Less Than	< 60 psig
3	13-PALL-112B/760B	Agent Feed Nozzle Pressure at High Feed Rate Less Than or Equal to	≤ 5 psig active 10 sec after LIC agent feed pump is started and at feed rates greater than 500 lbs/hr
5	13-TIT-610/710	Primary Chamber Temperature Less Than	< 2,500° F, one-hour rolling average
5.a	13-TAHH-610/710	Primary Chamber temperature Greater Than or Equal to	≥ 2,850° F
6	13-FIC-102/763	Spent Decon Feed Rate Greater Than or Equal to	≥ 2,100 lb/hr over one-hour rolling
7	13-PSL-058/809	Spent Decon Atomizing Air Pressure Less Than or Equal to	≤ 60 psig
8	13-ZS-367B/567B	Slag Removal System Discharge Gate Open	Upper Cylinder Switch Closed
9	13-TIT-129/782	Secondary Chamber Temperature Less Than	< 1,800° F, one-hour rolling average
9.a	13-TAHH-129/782	Secondary Chamber Temperature Greater Than or Equal to	≥ 2,200° F
10	24-FIT-9431/9902	Exhaust Gas Flow Rate (Unit Production Rate) Greater Than or Equal to	≥ 9,500 scfm, one-hour rolling average
11	24-TSHH-089/800	Quench Tower Exhaust Gas Temperature Greater Than	> 225° F
12	24-PALL-100/838	Quench Brine Pressure Less Than or Equal to	≤ 40 psig
13	24-FIT-088/828	Brine to Venturi Scrubber Flow Less Than or Equal to	≤ 100 gpm one-hour rolling average
14	24-PDIT-090/814	Venturi Exhaust Gas Pressure Drop Less Than or Equal to	≤ 30 in. w.c., one-hour rolling average
15	24-FIT-112/825	Clean Liquor to Scrubber Tower Less Than or Equal to	≤ 400 gpm, one-hour rolling average
16	24-PIT-129/839	Clean Liquor Pressure Less Than or Equal to	≤ 35 psig, one-hour rolling average
17	24-AIT-091/831	Scrubber Brine to Venturi Scrubber pH Less Than to Equal to	≤ 7.0 pH, one-hour rolling average
18	24-DIC-083/835	Brine Specific Gravity Greater Than or Equal to	≥ 1.20 SGU, twelve-hour rolling average
19	24-AIT-078/716	Blower Exhaust CO Concentration Greater Than or Equal to	≥ 100 ppm, one-hour rolling average, corrected to 7% O ₂ , dry volume ^d
20	13-AIT-083/778	Blower Exhaust CO Concentration Greater Than or Equal to	≥ 100 ppm, one-hour rolling average, corrected to 7% O ₂ , dry volume ^d
21	24-AAL-210/717	Blower Exhaust Gas O ₂ Less Than or Equal to	≤ 3% O ₂
21.a	24-AAH-210/717	Blower Exhaust Gas O ₂ Greater Than or Equal to	≥ 15% O ₂
22	13-AAL-229/798	Blower Exhaust Gas O ₂ Less Than or Equal to	≤ 3% O ₂
22.a	13-AAH-229/798	Blower Exhaust Gas O ₂ Greater Than or Equal to	≥ 15% O ₂
23	PAS 704H/ 705H	PAS Blower Exhaust Agent Detected Greater Than or Equal to	≥ 0.2 SEL ^f
24	PAS 701G ^g	Common Stack Exhaust Agent Detect Greater Than or Equal to	≥ 0.2 SEL ^{ef}
24a	PAS 706V ^g	Common Stack Exhaust Agent Detect Greater Than or Equal to	≥ 0.2 SEL ^{ef}
24b	PAS 707H	Common Stack Exhaust Agent Detect Greater Than or Equal to	≥ 0.2 SEL ^{ef}
25	BRA-TNKS	Brine Surge Tanks 101, 102, 201, 202, Four Levels High-High (BRA-TNKS = 23-LSHH-002 and 23-LSHH-006 and 23-LSHH-702 and 23-LSHH-706)	18'3" Level
26	13-TAHH-374, 13-TAHH-375, 13-TAHH-376, 13-TAHH-377	SRS Shell Thermocouple Temperature Greater Than or Equal to	≥ 500° F

Footnotes:

^a Logic code description used to set the control WFCO alarms.

^b Rolling average means the average of all one-minute averages over the averaging period. A one-minute average means the averages of detector responses calculated at least every 60 seconds from responses obtained at least every 15 seconds.

^c Waste feed cut-offs recorded upon switch activation.

^d One hour rolling average is composed of the 60 most recent one-minute averages. Each one-minute average is composed of the 4 most recent instantaneous CO process variables occurring at 15-second intervals.

^e An Automatic WFCO occurs if the two on-line ACAMS are not staggered so that at least one unit is sampling the stack.

^f The alarm setting (in mg/m3) for H is 0.015

^g In accordance with condition 22.16.6.2 of the Agent Monitoring Plan for past agents, AWFCOs associated with GB and VX may be suspended if no waste containing the agent is "inside the facility boundaries".

Table D-2 LIQUID INCINERATOR MACT AUTOMATIC WASTE FEED CUTOFF				
PROCESS DESCRIPTION	ANALOG INSTRUMENT TAG ID ^a	WASTE FEED CUT OFF ALARM TAG ID	WASTE FEED CUT OFF ACTIVATION BASIS	MACT LIMIT ^b
Minimum Primary Chamber Outlet Temperature (F)	13-TIT-610/710 ^{c,d}	13-TALL-610/710	Hourly Rolling Avg	2,500°F
Minimum Secondary Chamber Outlet Temperature (°F)	13-TIT-129/782 ^{c,d}	13-TALL-129/782	Hourly Rolling Avg	1,800°F
Maxium Agent Feed Rate	13-FIT-127/731	13-FAHH-127/731	Hourly Rolling Avg	1,275 lb/hr
Maxium Spent Decon Feed Rate	13-FIT-102/763	13-FAHH-127/731	Hourly Rolling Avg	2,100 lb/hr
Chlorine and Chloride Feed Rate Greater Than or Equal To	Calculated Value	Calculated Value	12-hour Rolling Average	TBD by ATB/CPT
Ash Feed Rate Greater Than or Equal To	Calculated Value	Calculated Value	12-Hour Rolling Average	TBD by ATB/CPT
Low Volatile Metals (As, Be, Cr) Feed Rate Greater Than or Equal To	Calculated Value	Calculated Value	12-Hour Rolling Average	TBD by ATB/CPT
Semi-Volatile (Cd, Pb) Feed rate Greater Than or Equal To	Calculated Value	Calculated Value	12-Hour Rolling Average	TBD by ATB/CPT
Mercury Feed Rate Greater Than or Equal To	Theoretical Emission Calculation	Theoretical Emission Calculation	12-Hour Rolling Average	MTEC Calculation ^f
Clean Liquor pH Less Than or Equal To	24-AIC-116/832 ^{c,d}	24-AAL-116/832	Hourly Rolling Avg	7.0 pH
Clean Liquor Density Greater Than or Equal To	24-DIC-117/826 ^c	24-DAHH-117/826	12-hour Rolling Avg	1.20 SG
Packed Bed Differential Pressure Less Than or Equal To	24-PDIT-108/822 ^c	24-PDAL-108/822	Hourly Rolling Avg	0.5 inWC
V Cone Flow Rate Greater Than or Equal To	24-FIT-9431/ 9902 A-B ^c	24-FAH-9431/9902 A-B	Hourly Rolling Avg	9.50 kscfm
V Cone Flow Rate Less Than or Equal To	24-FIT-9431/ 9902 A-B ^c	24-FAL-9431/9902 A-B	Hourly Rolling Avg	6.0 kscfm
Venturi Pressure Drop Less Than or Equal To	24-PDIT-090/814 ^c	24-PDAH-090/814	Hourly Rolling Avg	30.0 inWC
Brine to Venturi Scrubber Less Than or Equal To	24-FIT-088/828 ^c	24-FAL-088/828	Hourly Rolling Avg	100 gpm
Clean Liquor to Scrubber Tower Less Than or Equal To	24-FIC-112/825 ^c	24-FALL-112/825	Hourly Rolling Avg	400 gpm
Clean Liquor Delivery Pressure Less Than or Equal To	24-PIT-129/839 ^c	24-PALL-129/839	Hourly Rolling Avg	35 psig
Quench Brine Density Greater Than or Equal To	24-DIC-083/835 ^c	24-DAHH-083/835	12-Hour Rolling Avg	1.20 SG
Brine to Venturi Scrubber pH Less Than or Equal To	24-AIC-091/831 ^{c,d}	24-AALL-091/831	Hourly Rolling Avg	7.0 pH
Blower Exhaust Gas CO Concentration Greater Than or Equal To	13-AIT-083/778 ^{c,e}	13-AAH-083/778	Hourly Rolling Avgcorrected to 7% O ₂ dry volume	100 ppm
Blower Exhaust Gas CO Concentration Greater Than or Equal To	24-AIT-078/716 ^{c,e}	24-AAH-078/716	Hourly Rolling Avgcorrected to 7% O ₂ dry volume	100 ppm
Footnotes: a Calibration information (i.e., instrument ranges, accuracy, and methods and frequencies of calibration) is shown in Attachment 6 of TOCDF RCRA Permit. b Recorded upon activation or change of state of switch. c Continuously monitored with values being recorded electronically at approximately 30-second intervals d Only one analyzer is active at any one time. The active analyzer provides the process variable to the controller. Each analyzer is active an equal amount of time e One-hour rolling average is composed of the 60 most recent one-minute averages. Each one-minute average is composed of the four most recent instantaneous CC process variables occurring at 15-second intervals. f In accordance with condition 22.16.6.2 of the Agent Monitoring Plan past agents, AWFCOs associated with GB and VX may be suspended if no wastes containing the agent are "inside the facility boundaries". g Subject to change upon EPA approval of the Alternate Monitoring Request for maunual mercury emission monitoring.				

**MUSTARD AGENT TRIAL BURN PLAN
FOR THE
LIQUID INCINERATORS**

APPENDIX E

**MUSTARD AGENT
CHARACTERIZATION SUMMARY**

REVISION 1

April 6, 2006

SEE THE FILE :

Mustard Characterization Summary R1 – Sept 2005.PDF

**MUSTARD TRIAL BURN PLAN
FOR THE
LIQUID INCINERATOR (LIC)**

APPENDIX F

ALTERNATIVE MONITORING REQUESTS (AMR)

Revision 1

April 6, 2006

Alternative Monitoring Request (AMR)

Previously Submitted AMR

Two AMRs that were approved (on September 13, 2004; see DAQO-025-04) by the State of Utah Division of Air Quality (DAQ) during the VX Campaign will remain in effect during the Mustard Campaign. The TOCDF submitted documentation to support using exhaust gas flow rates as the operating parameter limits (OPLs) for the demisters, along with a preventative maintenance procedure for inspection of the demister candle sleeve integrity and support structure. These proposed limits and the inspection procedure ensure compliance with relevant emissions standards [i.e., for particulate matter (PM)] and will be used as an alternative OPL to the previously-identified differential pressure measurement across the demister candles.

In that same AMR, documentation was submitted to support a waiver to monitor levels of metals and/or chlorine in the natural gas and combustion air. The TOCDF was granted approval to waive the requirements for monitoring metals or chlorine in the natural gas fuel and combustion air used in the process.

The AMR will remain in effect as no change has been made to either the type of fuel gas or the demisters used in the process. Based on this AMR and other previously-approved AMRs, TOCDF plans to operate using the approved conditions during the Mustard Campaign.

**MUSTARD AGENT TRIAL BURN PLAN
FOR THE
LIQUID INCINERATORS**

APPENDIX G

**LIQUID INCINERATOR MUSTARD AGENT TRIAL BURN
FINAL REPORT OUTLINE**

Revision 1

April 6, 2006

APPENDIX G

LIQUID INCERATOR MUSTARD AGENT TRIAL BURN FINAL REPORT OUTLINE

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